DOCUMENT RESUME

ED 327 699 CE 056 760

TITLE Idaho Cooperative Demonstration Grant in Construction and Mining. Final Report.
INSTITUTION Idaho State Dept. of Education, Boise. Div. of Vocational Education.
SPONS AGENCY Office of Vocational and Adult Education (ED), Washington, DC.
PUB DATE 90
CONTRACT V199A90141
NOTE 678p.; Photographs will not reproduce well.
PUB TYPE Reports - Descriptive (141) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF04/PC28 Plus Postage.
DESCRIPTORS Access to Education; *Apprenticeships; *Building Trades; *Construction (Process); *Cooperative Programs; Curriculum Development; Driver Education; Employment Potential; Females; Job Skills; *Mining; Minority Groups; On the Job Training; Postsecondary Education; Program Development; Program Effectiveness; *School Business Relationship; Work Experience Programs
IDENTIFIERS *Idaho; Truck Drivers

ABSTRACT

A project was conducted in Idaho to develop, implement, evaluate, and disseminate a cooperative construction and mining training program to provide preapprenticeship training in construction trades, equipment operation and construction truck driving, apprenticeship-related instruction, and classes in more technical areas for journeyworker upgrading. The cooperative program was a joint effort between the Consortium of Area Vocational Education Schools (CAVES), Associated General Contractors (AGC), Bureau of Apprenticeship and Training (BAT), and mining companies in Idaho. During the project, preapprenticeship programs particularly for females and minority groups in equipment operation and/or construction truck driving were provided; preapprentices were given related instruction in the five basic construction trades; and related instruction for mining apprentices and upgrade classes for journey construction workers in technical areas were developed. The project served more than 700 participants. (Curriculum guides developed for the courses constitute the largest part of this report.) (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* · from the original document. *
****

ED327699

COOPERATIVE DEMONSTRATION GRANT

FINAL REPORT

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

GRANT AWARD NUMBER
V199A90141
January 1989 - June 30, 1990

CE056760

BEST COPY AVAILABLE

IDAHO COOPERATIVE DEMONSTRATION GRANT IN CONSTRUCTION AND MINING

TABLE OF CONTENTS

A. EXECUTIVE SUMMARY

1. Background

2. Program Overview
   - a. Initiation
   - b. Development
   - c. Operation
   - d. Recordkeeping and Reporting

3. Project Objectives

4. Performance Report--Actual Accomplishments
   - a. Programs Conducted
   - b. Services by Region
   - c. Programs that Continue

B. FINANCIAL REPORT
   - a. Subproposal Chart
   - b. Subproposal Match
   - c. Financial Status Report

C. DISSEMINATION

D. EVALUATION
   - a. Mining
   - b. Construction
   - c. Agency Coordination
   - d. Outside Evaluation

E. RECOMMENDATIONS

F. APPENDIX

G. STAFF INSERVICE TRAINING MANUAL

H. CURRICULA DEVELOPMENT

IDAHO COOPERATIVE DEMONSTRATION GRANT
IN CONSTRUCTION & MINING
V199A90141
US DEPARTMENT OF EDUCATION

EXECUTIVE SUMMARY

Background

This internal program evaluation is being conducted on the basis of information provided to the State Division of Vocational Education by the postsecondary vocational-technical institutions.

The grant proposal was generated in the summer of 1988. The construction industry had witnessed a yearly increase of 8% for the last three years. Large mining companies were reopening and expanding mining operations as the price of both gold and silver were very favorable for profit-making.

The grant was for eighteen months and was directed toward the five basic construction trades and underground mining operations. The construction trades included heavy equipment operators, construction truck drivers, laborers, carpenters, and cement masons. The levels of training included pre-entry and pre-apprenticeship through supervisors and contractors programs. The service was to be offered statewide through the Consortium of Vocational-Technical Institutions (CAVES). Idaho is divided into six planning regions with a postsecondary vocational-technical school in each region.

The goals of the construction and mining programs were to develop curriculum, assist contractors in meeting their EEO compliance, serve a total of 774 participants, and develop a closer working relationship between vocational education and public and private agencies and organizations involved in construction.

Half-time staff were to be hired and placed at each of the six institutions and the State Division of Vocational Education. Subproposals were generated by the postsecondary institutions and submitted to the State Division for formal approval. Subproposals could be conducted by staff or delivered through project specialists.

Program Overview

The project began in January 1989. Each of the six postsecondary vocational-technical schools employed a half-time coordinator/instructor. A half-time construction and mining specialist was hired and housed within the State Division of Vocational Education. The staff were all brought to Boise for a four-day orientation and inservice training. The training was conducted by the Project Director and the Construction and Mining Specialist. The Bureau of Apprenticeship and Training (BAT), Associated General Contractors (AGC), and the Idaho Transportation Department (ITD) participated in the presentations.

Prior to the inservice training, a flagging and basic traffic control program had been developed by the Construction and Mining Specialist and the Safety Officer of the ITD. During the inservice training all staff obtained state certification as instructors for this new curriculum. This was the first of three statewide sub projects.

Program Development

The short-term coordinators in each of the six postsecondary vocational-technical institutions provided immediate supervision to the construction instructors. This supervision set the pattern for the involvement of that institution. In some cases the short-term coordinator developed and wrote the subproposals. In other cases the subproposals were developed and written by the construction coordinators/instructors. Subproposals were forwarded to the Project Director for review to ensure they met the intent of the project and that costs were just and reasonable. Final approval was given by the State Administrator of the State Division of Vocational Education, and a funding letter was sent to the appropriate institution.

Program Operation

Subproposals were advertized through a variety of sources: TV, newspapers, construction organization newsletters and direct contact with industry. Much of the training did not occur at vocational-technical institutions. All of the mining programs were conducted in a mine tunnel in Northern Idaho. All the heavy equipment operation programs were conducted at industries facilities. Most of the flagging/basic traffic control programs were conducted at vocational-technical education facilities. However, on occasion, these programs were conducted elsewhere. The location for conducting programs was in part determined by the availability of facilities and equipment that could be provided by industry.

Recordkeeping and Reporting

Records were maintained within each institution. This included participants attendance, program evaluation, and expenditures of funds. The records and activities were forwarded to the State Division of Vocational Education. Reimbursement requests for approved expenditures of funds were forwarded to the State Office after the service had been provided.

PERFORMANCE REPORT

Programs Conducted

1. Asbestos Abatement
2. Concrete Technology
3. Diamond Drilling
4. Underground Miners
5. Carpentry
6. First Aid
7. Heavy Equipment Operators (Upgrading)
8. Heavy Equipment Operators (Pre-apprenticeship)
9. Backhoe Operators
10. Basic Surveying
11. Blueprint Reading
12. Hazardous Material
13. Supervisory Training
14. OSHA Construction Regulations
15. Bid/Tender Forms
16. EEO Compliance
17. Conditions of Contracts
18. Agreement Forms
19. Contract Negotiations
20. Construction Coordination
21. Federal Contracts for Minorities
22. Critical Path Method
23. Contract Submittal
24. Bidding and Contract Regulations
25. Drug-Free Workplace
26. Construction Safety
27. Hazardous Materials Communication Law
28. Progress Schedules
29. Special Projects Procedures
30. Building Trades Pre-apprenticeship
31. Pre-apprenticeship (General)
32. Welding

Statewide Programs

33. Flagging
34. Construction Truck Driver (Federal Regulations)
35. Computer Tracking of Unemployed Workers

PROJECT OBJECTIVES

The purpose of this project was to develop, implement, evaluate and disseminate a cooperative construction and mining training program; to provide pre-apprenticeship training in equipment operation and construction truck driving; apprenticeship related instruction; and classes in more technical areas for journeymen upgrading. This cooperative program was a joint effort between the Consortium of Vocation-Technical Institutions (CAVES), Associated General Contractors (AGC), Bureau of Apprenticeship and Training (BAT), and five mining companies in northern Idaho.

The quantitative objectives were as follows:

a. Provide pre-apprenticeship programs for approximately 30 female and minorities in equipment operation and/or construction truck driving.

b. Provide approximately 250 pre-apprentices with related instruction in the five basic construction trades--equipment operation, construction truck driving, cement masonry, carpentry, and laborers.

c. Provide 480 hours of related instruction for 144 mining apprentices for mining companies.

d. Provide upgrade classes for approximately 350 journeymen in technical areas.

Noted in the support letters and in the State of Need was: (1) the shortage of related instruction programs for apprentices, (2) today's construction workers are not necessarily unskilled but area less skilled than is required, (3) the mining and construction industries are expanding rapidly, and (4) a need for new skilled workers to enter the construction and mining industries.

PERFORMANCE BY REGIONS

The number of participants targeted for this proposal were 774. The total number served was 2,994. The following data will be broken down by the six areas of the state. The data will include projects funded through the subproposals and also those projects conducted at no cost to the grant and/or those supported in total by industry. These shall include those services provided by the coordinator/instructor where additional funds were not necessary. The categories will be: (1) subproposal services, and (2) non-subproposal services.

North Idaho College - Region I

Subproposals:
- Flagging
- Truck Driving
- Underground Miners
- Diamond Drillers

Non-Subproposals:
- First-aid
- Concrete Technology
- Pre-apprenticeship
- Construction Supervision
- Carpenter
- Apprentice Welding*

Continuing Programs:

An apprenticeship carpentry program has been developed for six contractors and will begin in September 1990.

A self-study program will be implemented in August 1990. The program is designed to assist truck drivers to pass the new commercial drivers license examination.

*The grant coordinator/instructor established a welding program for apprentices. The program has served 130 participants thus far and will continue in the fall of 1990.

Lewis-Clark State College - Region II

Subproposals:
- Flagging
- Truck Driving
- Heavy Equipment Operation
- Contractor Training
  - a. Bid/Tender Forms
  - b. EEO Compliance
  - c. Condition of contracts
  - d. Agreement forms
  - e. Contract negotiations
  - f. Construction coordination
  - g. Federal contracts for minorities
  - h. Critical path method
  - i. Contract submittal
  - j. Bidding and contract regulations
  - k. Drug-free workplace
  - l. Construction safety
  - m. Hazardous materials communication law

    n. Progress schedules
    o. Special projects procedures

Non-Subproposals:
    Truck Driving CDL Information

Boise State University - Region III
Subproposals:
    Flagging
    Truck Driving
    Heavy Equipment Operator
    Concrete Technology

Non-Subproposal Services:
    Hazardous Materials

Continuing Programs:
As a result of the grant proposal a full-time carpentry program will commence in August 1990. The project will be totally state funded.

a guidance program will be piloted in 15 junior high schools. Counselors will teach units on apprenticeship programs.

The Idaho Concrete and Aggregate Producers Association has conducted another concrete technologies program for architects. Another is planned this winter.

College of Southern Idaho - Region IV
Subproposals:
    Flagging
    Truck Driving
    Building Trades Pre-apprentice
    Carpentry

A referral system for unemployed construction workers has been developed with the Idaho Department of Employment. Unemployed construction workers will receive a listing of all construction training in their areas. The project will be an ongoing program and has been initiated statewide.

Idaho State University - Region V
Subpropoals:
    Flagging
    Truck Driving
    Heavy Equipment Operator
    Basic Surveying
    Blueprint Reading
    Concrete Technology

Non-Subproposals:
    OSHA Construction Regulations

Eastern Idaho Technical College - Region VI
Subproposals:
    Truck Driving
    Asbestos

Hazardous Materials

Non-Subproposals:
Flagging

The grant coordinator/instructor assisted the Bureau of Apprenticeship and Training in organizing an apprenticeship conference to be held in Idaho Falls in October, 1990.

Programs That Will Continue After Grant Terminates
The following projects have been developed as a result of the coordinators/instructors with the construction industry:

1. A pre-apprenticeship carpentry program has been funded for Boise State University with State funds. This program will articulate with five public school districts in Southern Idaho and will commence in September, 1990.

2. A carpentry apprenticeship program has been developed for six contractors in Northern Idaho. This program will be conducted through North Idaho College and will commence in the Fall of 1990.

3. A guidance program through the State Division of Vocational Education will provide for the teaching of apprenticeship opportunities. The program will become part of the curriculum at the junior high schools.

4. A self-study course for Commercial Drivers License has been established at North Idaho College. The program assists drivers in preparation for the exam required under new federal regulations to obtain the Commercial Drivers License (CDL).

5. A training venture between the State Division of Vocational Education and the Idaho Transportation Department has resulted in a Memorandum of Agreement and a statewide continuation of services.

   The agreement provides for the postsecondary institutions to continue to provide flagging and basic traffic control certification.

6. A Memorandum of Agreement has been developed between the Department of Employment and the State Division of Vocational Education. The Department of Employment has modified its' computer system to provide the name and address of unemployed construction workers. The postsecondary institutions will then notify the unemployed workers on the availability of construction training programs.

COOPERATIVE DEMONSTRATION COORDINATOR CHART
FINAL PROJECT REPORT

6 half-time construction/mining coordinators
1 half-time construction/mining specialist

Contract Number	Dates	Grant Award	Actual Expenditure	Anticipated Match	Actual Match	Estimated Served	Actual Served
CD-89-01 BSU Coord.	1/2/89 - 6/29/90	$25,693.60	$26,060.68	N/A	N/A	99	624
CD-89-02 CSI Coord.	1/2/89 - 6/29/90	$25,693.60	$20,311.83	N/A	N/A	365	511
CD-89-03 EITC Coord.	2/12/89 - 6/29/90	$25,693.60	$20,403.74	N/A	N/A	64	50
CD-89-04 ISU Coord.	2/1/89 - 6/29/90	$25,693.60	$23,514.82	N/A	N/A	226	335
CD-89-05 LCSC Coord.	1/2/89 - 6/29/90	$25,693.60	$25,186.02	N/A	N/A	54	558
CD-89-06 NIC Coord.	1/2/89 - 6/29/90	$25,693.60	$25,992.35	N/A	N/A	57	370
CD-89-07 Specialist	1/2/89 - 6/29/30	$27,572.60	$23,757.12	N/A	N/A	N/A	N/A
TOTAL COORD. FUNDING		$181,734.20	$165,226.56	N/A	N/A	N/A	N/A
SUBPROPOSAL TOTALS						865	2,448
NON SUBPROPOSAL CONSTRUC. PROGRAMS							546
TOTAL SERVED							2,994

COOPERATIVE DEMONSTRATION SUBPROPOSALS FUNDED
January 1989 - June 1990

Project Number	Dates of Training	Grant Award	Actual Expenditure	Anticipated Match	Actual Match	Estimated Served	Actual Served
CD-89-08 Flagging BSU	3/29/89 - 6/21/90	$374.92	$374.92	$457.40	$457.40	12	553
CD-89-09 Flagging LCSC	4/18/89 - 6/ /90	$605.91	$605.91	$790.00	$790.00	12	168
CD-89-10 Heavy Equip BSU	3/5/90 - 4/27/90	$15,600.00	$15,600.00	$7,905.00	$7,905.00	12	9
CD-89-11 Mining NIC	1/23/89 - 4/14/89	$13,800.00	$13,800.00	$21,414.00	$49,435.00	18	15
CD-89-12 Flagging CSI	4/10/89 - 6/13/90	$168.60	self supported -0-	$279.69	-0-	40	214
CD-89-13 Carpentry CSI	4/18/89 - 5/27/89	$888.50	self supported -0-	$722.00	-0-	15	6
CD-89-14 Flagging ISU	4/18/89 - 6/ /90	$842.50	$842.50	$1,808.60	$6,599.40	96	253
CD-89-15 Flagging NIC	4/6/89 - 6/ /90	$1,095.63	self supported -0-	$370.03	-0-	15	331
CD-89-16 Asbestos EITC	7/10/89 - 4/20/90	$4,871.00	$4,245.00	$5,144.00	$7,931.00	40	40

Project Number	Dates of Training	Grant Award	Actual Expenditure	Anticipated Match	Actual Match	Estimated Served	Actual Served
CD-89-17 Mining NIC	5/1/89 - 7/31/89	$15,066.00	$15,060.00	$45,094.00	$37,833.00	18	18
CD-89-18 Drilling NIC	4/12/89 - 5/19/89	$8,814.00	$8,814.00	$1,633.00	$1,633.00	6	6
CD-89-19 First aid EITC	-0-	$574.00	Deobligated	$353.00	-0-	12	0
CD-89-20 Truck Driv. CSI	10/16/89 - 6/22/90	$31,637.00	$26,399.25	$5,100.00	$6,120.00	300	287
CD-89-21 Concrete BSU	11/28/89	$875.00	$549.25	$1,084.00	$4,128.00	75	62
CD-89-22 Hvy Op. Eq. ISU	11/9/89 - 11/28/89	$1,689.00	$1,417.00	$5,019.00	$5,154.20	16	12
CD-89-23 Surveying ISU	5/22/90 - 5/24/90	$900.00	$895.43	$2,566.00	$1,472.00	24	4
CD-89-24 Blueprint ISU	1/17/90 - 4/18/90	$1,600.00	$1,595.44	$277.00	$1,310.75	15	21
CD-89-25 Concrete ISU	11/30/89	$932.50	$789.85	$2,081.20	$3,049.68	75	45
CD-89-26 Haz Mat EITC	1/8/90 - 1/12/90	$1,250.63	self supportive -0-	$1,406.75	$1,239.73	12	10

Project Number	Dates of Training	Grant Award	Actual Expenditure	Anticipated Match	Actual Match	Estimated Served	Actual Served
CD-89-27 Bldg. Trds CSI	6/30/90	$28,037.00	$23,740.44	$12,408.00	$12,408.00	10	4
CD-89-28 Heavy Equip LCSC	4/12/90 - 5/25/90	$17,394.05	$15,955.23	$7,244.00	$8,366.20	10	11
CD-89-29 Blueprint LCSC	N/A	$8,767.40	Deobligated	$9,225.00	N/A	12	0
CD-89-30 Refer Sys CSI	5/31/90	$1,610.00	$1,600.00	$370.00	N/A	*(400) winter 1990-1991	
CD-90-01 Contrac Trn LCSC	7/1/89 - 5/31/90	$10,525.00	$9,570.73	$12,800.00	$27,510.00	20	379
SUBPROPOSAL TOTALS		**$167,918.64**	**$141,854.95**	**$145,551.67**	**$183,342.36**	**865**	**2,448**

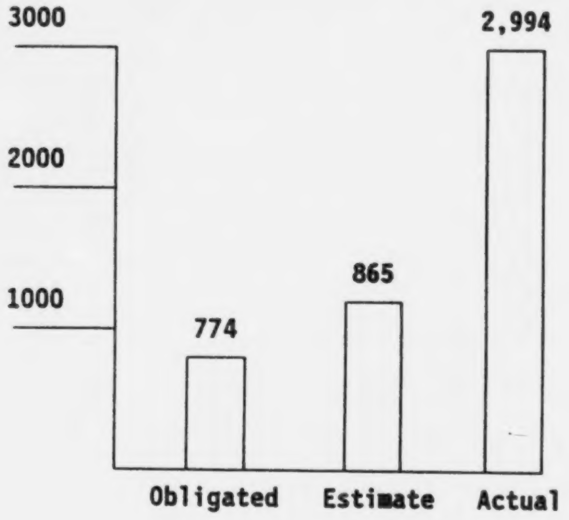
*Estimated served in the winter of 1990 - 1991. Not counted in total estimated served count.

NONSUBPROPOSAL COOPERATIVE DEMONSTRATION PROGRAMS
SELF-SUPPORTED

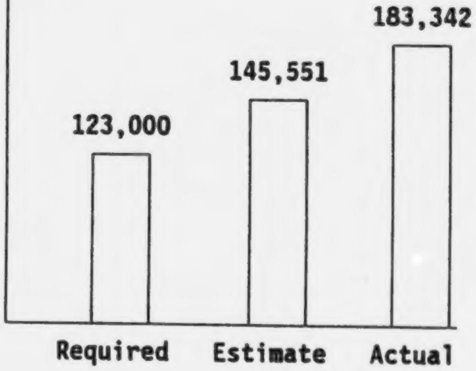
Project Title	Actual Served
Hazardous Materials--Boise State University	12
OSHA Construction Regs--Idaho State University	98
Apprenticeship Welding--North Idaho College	130
Concrete Technology--North Idaho College	80
First Aid--North Idaho College	35
Preapprenticeship North--Idaho College	11
Construction Supervisory Trng--North Idaho College	14
Carpenter Training--North Idaho College	1
Truck Driving, CDL Test Preparation Lewis-Clark State College	45
Flagging--Eastern Idaho Technical College	120

TOTAL NONSUBPROPOSAL	**ACTUAL MATCH**	**ACTUAL SERVED**
	11,367	546
GRAND TOTAL SERVED		**2,994**

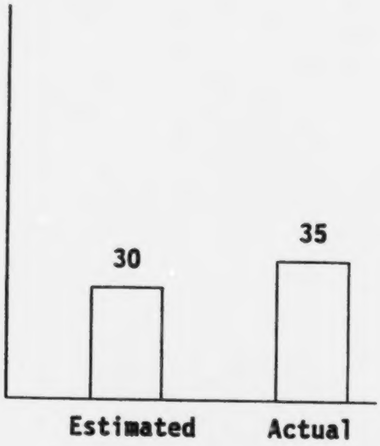
COOPERATIVE DEMONSTRATION PROJECT--V199A90141



Participants Served



In-kind Match



Number of Programs

Federal funds cost/benefit ratio:

Estimated cost per participant	$479
Actual cost per participant	$105

COOPERATIVE DEMONSTRATION GRANT
SUMMARY OF PAYMENTS
AS OF SEPTEMBER 28, 1990

GRANT AWARD			$371,673.00
PAYMENTS:			
	BOISE STATE UNIVERSITY	$66,341.97	
	COLLEGE OF SOUTHERN IDAHO	72,051.52	
	EASTERN IDAHO TECHNICAL COLLEGE	24,648.74	
	IDAHO STATE UNIVERSITY	29,055.06	
	LEWIS-CLARK STATE COLLEGE	51,317.89	
	NORTH IDAHO COLLEGE	63,666.35	
	NW REGIONAL EDUCATIONAL LABORATORY	4,000.00	
	IRREGULAR HELP	4,341.64	
TOTAL PAYMENTS			315,423.17
UNEXPENDED BALANCE			$56,249.83

DISSEMINATION

CAVES, in conjunction with the Associated General Contractors will disseminate the information. The information will include distribution to the (1) US Department of Education, (2) National Clearinghouse for Apprentice Programs, (3) University of Idaho Curriculum Dissemination Center, and (4) National Association of General Contractors.

CAVES will develop the following types of materials for dissemination:

1. Curriculum for pre-apprentice programs, related instructional material for apprenticeship programs, short-term specific skill oriented curricula, and curricula developed for construction coordinators.
2. Methods used for liaison and coordination with private industry.
3. Dissemination of how local, state, and federal agencies were used during the program.
4. Recommendations for modifying or improving the program development.

EVALUATION

Mining
The two types of programs designed for the mining companies consisted of underground miner and core driller projects. The curriculum development and quality of instruction appear excellent. However the number of people trained were far below the anticipated numbers. The prices of gold and silver fell drastically from the time of the initial writing of the proposal to when the second underground miner program was completed. The mining advisory committee recommended termination of training when silver went below six dollars an ounce. In June, 1990, silver reached a ten-year low in price. This financial situation appeared highly unlikely when the grant was being written. The financial conditions of the industry made the future placements of graduates unlikely and termination of training was in response to the lack of manpower needs.

Construction
The varied types of programs in construction reflect a more stop-gap need for immediate specific skills rather than a long-range total training plan. The programs that are being continued after the grant has expired are more reflective of long-term training needs.

The current manpower needs of the industry are still increasing at an 8% rate per year. Some regions are 20% above their construction levels for 1989. The grant was not able to keep abreast of the current needs as most of the training had to be conducted in the winter months when construction was at a minimum. Generally, the short-term one-skill programs can still be addressed when construction is in full swing.

Programs that were developed and then initiated statewide served a larger number of participants. The development of curriculum with the training material, audiovisual aids, and retraining of instructors appear to be the most productive programs.

AGENCY COORDINATION

Agency coordination has resulted in the following:

1. Memorandum of Agreement with the Idaho Transportation Department and the State Division of Vocational Education--The agreement states that vocational education will provide statewide delivery of flagging/traffic control programs for state certification.

2. Memorandum of Agreement between the State Department of Employment and the State Division of Vocational Education--This project modified the DOE computer system to identify unemployed construction workers by the DOT code numbers. The unemployed workers will be notified of construction training programs in their area.

3. Working agreement between the Federal Bureau of Apprenticeship and Training and the State Division of Vocational Education. Under this agreement vocational education will provide related instruction for

apprenticeship programs.

4. Coordination with OSHA and the State Division of Vocational Education were as follows:
    1. OSHA staff review and made suggestions on the safety manual for trade and industry programs.
    2. OSHA staff provided contractor training to construction worker safety programs.
    3. OSHA staff reviewed and approved a hazardous material communication program for vocational education delivery.

5. The Associated General Contractors provided:
    1. Inservice training to the coordinator/instructors of the grant.
    2. A person to develop public relations materials in apprenticeship to be used by junior high counselors.

6. North Idaho College developed an apprenticeship program to start in the Fall of 1990 for the Associated Building Contractors.

7. The State Division of Vocational Education provided funding for a carpenter program starting in August, 1990. The program articulates training between the Canyon-Owyhee School Service Agency and Boise State University.

8. Three vocational education institutions (Boise State University, Eastern Idaho Technical College, and College of Southern Idaho) developed subproposals with trade organization providing the training. The International Union of Operating Engineers and the Signatory Contractors provided training for heavy equipment operators. The Teamsters and the Signatory Contractors provided training for construction truck drivers. The Laborers Union and Associated General Contractors provided asbestos removal programs.

9. Numerous programs had referrals from Vocational Rehabilitation. The admission, training, and placements of vocational rehabilitation participants resulted in close working relationships between the institutions and Vocational Rehabilitation.

10. Participants were also served from the Dislocated Worker Program. The training of participants resulted in a closer working relationship between the Dislocated Worker Program and the vocational education institutions.

Final Evaluation Report

Idaho Cooperative Demonstration Project in Construction and Mining

Prepared by

Dr. Thomas R. Owens
Education and Work Program
Northwest Regional Educational Laboratory
101 S.W. Main Street, Suite 500
Portland, Oregon 97204

June 29, 1990

Final Evaluation Report of the Idaho Cooperative Demonstration Project in Construction and Mining

This final evaluation report summarizes the: 1) evaluation design; 2) a meeting held in Washington, D.C. with the project monitor; 3) the monthly reports by the six project coordinators; 4) staff interviews; and 5) summary of telephone interviews with industry representatives. The Idaho Cooperative Demonstration Project is being evaluated internally by the Project Construction Specialist and state staff, while the external evaluation is being conducted by the Northwest Regional Educational Laboratory (NWREL).

1. Evaluation Design

The external evaluation design was prepared by Dr. Thomas Owens of the NWREL staff in March 1989 and reviewed and approved by Dr. Don Eshelby, Program Services Director for the State of Idaho Division of Vocational Education. The design specifies the purposes for the evaluation, questions to guide the evaluation, data collection procedures, timeline, and reporting arrangements. A copy of the design is shown in Appendix A.

2. Interview with Program Monitor

On December 1, 1988, Tom Owens met in Washington, D.C. with Bob Miller regarding the Idaho Apprenticeship Project and their evaluation expectations. His branch chief, Glen Boerrigter, joined the group.

They are interested in whether the projects are successful and in how partnerships get developed with the private sector. However, officially, they cannot state what they want from the evaluations. They have also contracted with the Associated General Contractors in D.C. for a project. He felt that both AGC and NOCCTI may have some useful student tests. Clev Randall from their division of vocational technical education is their contact person for the Department of Labor. I wanted to visit Randall, but he had already left for AVA.

Their office moved recently and they got rid of many documents. Therefore, they had no exemplary evaluation designs or reports to share with Dr. Owens.

3. Summary of Monthly Reports

This section starts with a narrative summary of program accomplishments and then displays a monthly tabulation of people served and contacts made by the coordinators.

27

Narrative Summary

SCHOOL	NAME	TIME COVERED
College of Southern Idaho	Bennie Knodel	June 1989-January 1990

Bennie Knodel visited with various contractors, held flagging/basic traffic classes, and planned classes in first aide, blueprint reading, and other pre-apprenticeship classes. His contractor survey indicated the greatest training interest in: first aide and CPR (15 people) and blueprint reading (9 people).

North Idaho College	Richard Caron	January-May 1989
	Don Bennett	July-February 1990

Richard Caron attended a 40-hour Mine Safety and Health Administration training class in January, collected safety training materials and curricula, and became familiar with the mine site and instructors. He coordinated the hard rock mining and the diamond drilling programs. A segment of the training was shown on KHQ television in Spokane.

Don Bennett planned and organized the eight-hour 1990 National Electronic Code (NEC) Update class for electricians which was taught in April. He also met with representatives of NIC and the USDA Soil Conservation Service to discuss a proposed soils technician two-year degree program and with representatives of the Potlatch Complex in St. Maries to review their proposed apprenticeship program. Arrangements were also made with company representatives to implement pre-employment training, apprenticeship training, and a rehabilitation training program. He also implemented a truck driver qualification program.

A hard rock mining school was held in July but there was inadequate labor market need to justify future classes in this area. Don started a pre-apprenticeship class plus two flagging classes. He also made regular contacts with contractors and contractor associations and distributed a flyer for a truck driver training program.

Idaho State University	Duane Gagon	April-December 1989

Duane Gagon conducted flagger classes for 108 people and updated the manual. Visits were made to contractors concerning a blueprint reading class and one on backhoe operations. He also attended the Backhoe training for the City of Blackfoot and arranged for a Concrete Seminar attended by over 40 people.

Lewis-Clark State College	K.D. Dempsey	July-November 1989

Mr. Dempsey made numerous contacts with contractors and developed curricula in construction, truck driving, first aide and CPR, blueprint reading, sheet metal, construction equipment operations, and hazardous material communication.

Eastern Idaho Vocational-Technical School Roger Orme February-November 1989

Roger Orme attended asbestos upgrade training in Albuquerque, New Mexico, conducted flagging classes, organized asbestos classes, contacted mining companies, and conducted apprenticeship orientation. He also mailed surveys to 169 area contractors and got labor union input. The contractor surveys indicated the greatest training needs in: supervisory training program (checked by 68 percent of the contractors) first aide and CPR (64 percent), blueprint reading (60 percent), and concrete seminar (48 percent).

Roger's contacts with small businesses generally indicated they were not highly interested in training and were fearful of forming, jointly with their competitors, a training pool of workers. The people from Salmon asked to have a flagging class there.

He attended the Rocky Mountain Apprenticeship conference in Reno, Nevada.

TABLE 1

Monthly Tabulation of Coordinators' Monthly Reports

	1 Boise State University	2 College of S. Idaho	3 Eastern ID VTS	4 Idaho State University	5 Lewis-Clark State College	6 N. Idaho College
Number of Pre-Apprentices Served	*1	*2	85	148	44	54
Number of apprentices Served			64		18	0
Number of Journeymen Served					62	63
Number of Females and Minorities Served					98	40
Number of Curricula Developed				1	16	4
Staff Training Sessions Attended				3	11	2
Public and Private Sector Contacts		64	6	59	294	231

Notes:
1. No data reported
2. Data reported in terms of coordinator's time rather than people served
3. February to November
4. April to December
5. March to October
6. January 1989 to February 1990 data

Idaho Cooperative Demonstration Project
Employer Interview

Following an introduction of myself and brief purpose for the interview, the following questions will be asked:

1. What type of training was conducted in your company through this project?
2. About how many people were trained?
3. What do you think were the strengths of this training?
4. What do you think were the weaknesses of this training?
5. Would you be interested in having the same type of training provided in the future? Why?
6. Would you be interested in having other types of training provided? If yes, what types?

4. Interview with Division of Vocational Education Staff

The Idaho Cooperative Demonstration Project in Construction and Mining was considered by state staff to have made some important contributions in Idaho. Between 2,500 and 3,000 people were trained through this project. Most of them were trained in flagging. The curriculum developed was considered excellent and the Idaho Transportation Department will contract to have the training provided through the vocational education system. Relationships with the Department of Employment have improved and a system has been developed to identify construction people who are unemployed. These people are sent a flyer describing construction training programs offered through the state's vocational technical schools. The truck driver training developed through this project may be picked up by the unions. The carpenter training will be offered in September through Boise State University for high school and adult populations. High school students can attend on a half-day basis as a result of an articulation agreement with the public schools. High school counselors were educated to teach students about apprenticeship opportunities in their community.

Although the training project was considered successful, it did not reach as many people as possible. Staff feel that apprenticeship training could be offered in every city in the state.

5. Interview with Employers

Dr. Owens conducted six telephone interviews with a sample of employers in five areas of the state. The purposes of the interviews were to determine the type of training provided, perceived strengths and weaknesses of the training, whether employers would be interested in having the same type of training in the future, and what additional types of training might be desired.

The training covered flaggers, truck drivers, concrete workers, and construction workers. Training usually ran 4 to 8 hours and was provided to 3 to 20 workers per company. In each company, the employer spoke positively about the training and quality of instructors. The visual training aids were considered particularly good in the traffic control classes. Instructors were considered knowledgeable in their fields, informed about the new regulations, and able to relate to the workers. At least one instructor also helped the employer learn where to go for extra help and resource materials needed.

Only two areas were suggested for improvement. One was to lengthen the flagger training by adding one day of hands-on practice. The other was to make the safety training more specific to the needs of their particular company.

Several employers were uncertain as to whether they would want more of the training received. One company was considering providing their own flagger training and several felt the training provided had already met their needs. In terms of other areas where training would be desired, the only examples given were for first aid and advanced first aid training.

APPENDIX A

EVALUATION DESIGN FOR THE IDAHO COOPERATIVE DEMONSTRATION PROJECT IN CONSTRUCTION AND MINING

Prepared by:

Dr. Thomas R. Owens
Education and Work Program
Northwest Regional Educational Laboratory
101 S.W. Main Street, Suite 500
Portland, Oregon 97204

March 6, 1989

EVALUATION DESIGN FOR THE IDAHO DEMONSTRATION PROJECT IN CONSTRUCTION AND MINING

This design is intended to guide the 1989-90 external evaluation of the Idaho Cooperative Demonstration Project. The Northwest Regional Educational Laboratory (NWREL) has been contracted by the Idaho Division of Vocational Education and CAVES to conduct an independent evaluation of the Project. The design consists of the proposed evaluation questions to guide the evaluation, data collection procedures, timeline, and reporting arrangements. The evaluation is being conducted to provide feedback to the staff for program improvement and to document the processes and outcomes of the Project. The latter information should be of special interest to those thinking of adopting all or part of this Cooperative Demonstration project, to policy makers, and to staff of the U.S. Department of Education.

In addition to this external evaluation, the Project Construction Specialist and State Staff will be conducting an internal evaluation. The internal evaluation will measure the quality of instruction, course content, and program efficiency. The internal evaluation will include a student survey and an administrative evaluation regarding the quality of instruction, course content, instructor effectiveness, and quality of facilities. As part of the external evaluation, the NWREL staff will review the internal evaluation findings.

Evaluation Questions

The external evaluation questions were developed as a result of reviewing the project proposal, discussing the information needs with the project monitor in Washington, D.C. and discussion with the Project Construction Specialist.

1. To what extend are the program objectives being met in terms of:

    a. Developing an approved curriculum in construction and mining
    b. Providing preapprenticeship training in equipment operation and/or—construction truck driving to approximately 30 women and monitories—
    c. Providing approximately 250 students with related instruction in the five basic construction trades--equipment operation, construction truck driving, cement masonry, carpentry and laborers
    d. Providing 480 hours of instruction for 144 mining students
    e. Providing upgrade classes for approximately 350 students in technical areas
    f. Forming and working effectively with advisory committees in the technical areas, and
    g. Collaboration established between CAVES, the Associated General Contractors, Bureau of Apprenticeship and Training, and the participating employers and organizations

2. What contributed to the successes and failure of the various components of the project?

How effectively has [illegible] [illegible] [illegible]
interested parties in [illegible]

Data Collection Procedures

Because the resources available for the NWREL external evaluation are quite limited, we will rely on analysis of the internal evaluations where possible and will synthesize project documents such as the monthly reports from the separate sites. In addition, we will conduct telephone interviews with key staff at a sample of four of the Cooperative Demonstration project sites to determine progress, problems encountered, and suggestions for improvement. The NWREL evaluator will meet with the Advisory Committee at the end of year one to share the external evaluation findings.

Timeline

Listed below are the three major tasks and the proposed timeline for each.

Task	Completion Date
Evaluation design	March 15, 1989
Interim evaluation report	December 31, 1989
Final evaluation report	June 30, 1990

Reporting Arrangements

The dates for the interim and final report are specified in the timeline above. The evaluator will make an oral presentation at the meeting with the Advisory Committee. In addition to the final report the evaluator will prepare a one to three page executive summary that can be shared widely. Although budget limitations preclude the evaluator from meeting with the Advisory Committee on a regular basis, he will be readily available by telephone contact.

RECOMMENDATIONS

1. The development of statewide programs appear to be the most efficient in terms of participation. It is recommended that the subproposals with the needed curriculum and all the teaching aids be developed and then initiated in each area. Pre-training of instructors for consistency of program delivery appears to be an excellent idea. Continuity and consistency of programs from region to region with uniform certification standards of participants throughout the state.

2. Program development needs to be conducted and tested with industry prior to statewide initiation. Curriculum format and the materials selected need to be continually updated to the degree that a curriculum specialist should be employed the first part of a similar grant proposal. The purchase of available training programs may be a good idea but must be tested on industry prior to implementation.

3. The main disadvantage to providing service to construction companies was the registration fees established by the institutions. The needs of the construction industry were often times three or four hour-long training programs dealing with specific information. A twenty dollar or more registration fee is unrealistic when an instructor that is already paid goes to a company and provides an OSHA construction regulation, respirator training, or the hazard communication requirements. The normal registration fees were not out of reason when programs lasted 40 hours or more.

4. The construction industry is a difficult industry to provide training services to because of the seasonal nature of work. When construction is active jobs are normally plentiful. Training at this time is limited to short-term programs where training is a prerequisite. During the winter months when construction is curtailed the workers are available for training, but are often times looking for work in other areas. It is recommended that the long-term programs be conducted in Idaho in November - April.

5. Future funding for construction programs should center around the various contractor associations. It is recommended that the various associations develop training funds. Each company would contribute a certain number of cents per hour for each hour a worker is on their payroll. Each association would control their own funds and identify their own training needs. The training could be done by the association or through the state vocational education system.

6. Industry along with vocational education need to approach the legislature for funding for a construction specialist to maintain the statewide continuity of programs. Ground work needs to be laid in matching manpower needs with available participants. This is no easy task as the five basic construction trades represent over 400 job classifications.

APPENDIX

Table of Contents

1. Job Description - State Construction Specialist
2. Job Description - Coordinators/Instructors
3. Program Advertisements (Samples)
4. Construction Newsletter
5. Cooperative Work Agreements
    1. Boise State University and State Division of Vocational Education
    2. Idaho Transportation Department and State Division of Vocational Education
    3. Department of Employment and State Division of Vocational Education
    4. Bureau of Apprenticeship and Training and State Division of Vocational Education
6. Mining
    1. Apprenticeship Standards
    2. News Release
7. Truck Driving Programs

JOB DESCRIPTION

STATE CONSTRUCTION SPECIALIST

GENERAL

The statewide construction specialist shall be responsible for providing

1. Consultation and training to the coordinators/instructors.
2. Develop statewide linkages with private and public organizations.
3. Develop and assist in the development of needed curriculum.

SPECIFIC

1. Provide coordinator training with the following organizations and subject matter.
    - A. State EEO requirements
    - B. Construction code (OSHA)
    - C. Guidelines and operations of the Bureau of Apprenticeship and Training.
    - D. Flagging and traffic control on construction projects.
    - E. Personal protective safety.
    - F. Orientation to contractor organizations.
    - G. Organize labor involvement.
    - H. Review the guidelines for this cooperative demonstration project.
2. Consultation to post secondary coordinators as to processes to use, agencies to contact, how to establish programs, etc.
3. Establish construction curriculum programs to be housed in the state office. Assist coordinators in the development of curriculum, identification of teaching aids available for the construction industry. Materials such as, construction safety materials, visual aids, VCR and films available, concepts of "classroom" vs "hands on" vs "OJT" vs related instruction and when and how to apply these concepts.
4. Development of statewide linkages with private and public organizations. Included, but not limited to, the following:
    - A. Associated General Contractors
    - B. Associated Building Contractors
    - C. Unions of the five basic trades
    - D. Building Trades Associations
    - E. Idaho Department of Transportation
    - F. Bureau of Apprenticeship and Training
    - G. Occupational Safety and Health Administration
    - H. American Red Cross
    - I. Private training resources available
    - J. National construction training organizations
    - K. Vocational education in other states that provide construction training
5. Provide to the coordinators the major construction projects that are being bid in their respective areas
6. Gather, review, organize and submit all data to the State Director of Training for evaluation and future dissemination of lliterature about the project
7. Provide any service relevant under the supervision of the State Director of Training.

JOB DESCRIPTION

POST SECONDARY CONSTRUCTION COORDINATORS/INSTRUCTORS

GENERAL

The coordinators shall establish, and in some cases, instruct related training for apprentices, specialized training for journeymen upgrading and become a safety resource person in their institution.

SPECIFIC

1. Conduct construction needs assessment within the institutions' service delivery area.
2. Establish construction advisory committees when appropriate.
3. Coordinate programs with area private and public organizations.
4. When appropriate, instruct in areas of specialized training.
5. Resource person on construction codes from local, state, and federal regulations (OSHA, EDA, IDOT).
6. Develop and submit subproposals:
   a. Statement of need, b. course outline, c. budget narrative
7. Coordinate the use of facilities and instructor and recruitment of students for approved construction programs.
8. Maintain data for the evaluation and future dissemination of the program.
   a. People and agencies contacted.
   b. All needs assessment (positive and negative)
   c. Number of all students, preapprenticeship, apprenticeship, journeyman upgrading, etc. entered, completed, placed, or reentered industry.
   d. Assisting contractors to meet EED requirements.
   e. All curriculum development
   f. Data on how local, state and federal agencies were used.
   g. Methods used for liaison and coordination with private industry.
   h. Cost benefit ratio for each program.
   i. Coordinate data requirements from the State Division of Vocational Education with the institution.
9. Job site follow up on any apprenticeship programs developed where apprentices are in an O.J.T. program.
10. Act as a public relations proponent for job entry into the construction industry. They shall publicize the construction programs and the rewards of working in the construction industry.

LEARN TO EARN
WITH
HEAVY EQUIPMENT OPERATION TRAINING

SPONSORED BY
BOISE STATE UNIVERSITY

WHEN:	Starting March 12, 1990
WHERE:	Boise, Idaho
LENGTH:	Eight weeks--8 a.m. - 5 p.m.
COST:	$2,000 per participant
CURRICULUM:	- Equipment nomenclature and safety - Operation and service maintenance of equipment - Field application of equipment (doser, scraper, grader, loader, roller and backhoe)
ELIGIBILITY:	18 years of age, good physical condition, high school graduate or GED, and like working out of doors. Valid drivers license.
HOW TO APPLY:	Call or write: Vocational Student Services College of Technology Boise State University 1910 University Drive Boise, ID 83725 Phone: (208) 385-1144 Toll free within Idaho 1-800-632-6586

Eligible applicants may qualify for Job Training Partnership Act (JTPA) funding. Contact Jane Giles, JTPA Coordinator, 385-3353. Toll free within Idaho 1-800-632-6586, ext. 3353.

Boise State University is an equal opportunity/affirmative action institution.

Concrete Technology Seminar

SPONSORED BY:

BOISE STATE UNIVERSITY
and
IDAHO CONCRETE &
AGGREGATE PRODUCERS ASSOCIATION

DATE:	November 28, 1989
TIME:	9:30 a.m. - 4:00 p.m.
LOCATION:	Boise State University Student Union Big Four Room
COST:	$10 per person Preregistration form enclosed

TENTATIVE AGENDA

A.M.	Finishing & Curing Quality Concrete Trouble Shooting Hot and Cold Weather Concrete Quality Control
P.M.	Admixtures Use of Fly Ash Certification Program for Testing Architectural Concrete

Applicants are asked to preregister by completing the enclosed application and mailing the application and a check for $10 made payable to Boise State University, Vocational Extended Programs, 1910 University Drive, Boise, ID 83725.

Try to have your registration completed by November 21, 1989, so we can make adequate accommodations for all participants.

For more information contact Don Owen, Statewide Construction Specialist, 334-3216

COLLEGE OF SOUTHERN IDAHO
315 Falls Avenue ● P.O. Box 1238
Phone 208-733-9554
Twin Falls, Idaho 83303-1238

NOTICE

NEW PROGRAM

BUILDING TRADES

A new program in the area of Building Trades will be offered at College of Southern Idaho. Skill development will be with the required tools and techniques for building construction. Included is foundation, framing, dry-wall, roofing and all other areas required for the trade.

This program will enroll ten (10) students for approximately four months. Starting date will be March 15, 1990, ending in July, 1990. The cost to enroll in the program is $400. Books and hand tools are provided by the program.

For more information call the College of Southern Idaho at 733-9554, Ext. 250.

North Idaho College

COMMERCIAL DRIVER'S LICENSE

EXAMINATION PREPARATION

Idaho is implementing a Commercial Driver's License (CDL) Program designed to improve highway safety by meeting federal requirements for testing and licensing commercial drivers. Drivers will be required to have a CDL to operate any of the following vehicles:

- A vehicle or combination of vehicles with a gross vehicle weight rating (GVWR) of more than 26,000 pounds;
- A vehicle designed to transport 16 or more persons, including the driver;
- Any size vehicle which requires hazardous material placards.

A written General Knowledge test will be required to get a basic CDL. The following additional written knowledge tests will be required for endorsements or to avoid restrictions:

- Hazardous Materials
- Double/triple Trailers
- Passengers
- Tank Vehicles
- Air Brakes (test required to avoid prohibition)

Skills (driving) test(s) will also be required for new drivers and some others.

North Idaho College has a video based self-study training program available to help drivers prepare for the required examinations. The program includes (1) a pre-test and (2) a video test correction program (Tests must be returned at the end of the session).

Contact our Learning Center on the second floor of the Hedlund Vocational Center (208/769-3450) to register. Allow approximately 3 1/2 hours for a complete session. Special group rates and schedules are available.

Costs: $25 per driver for general knowledge including any needed endorsement areas. $10 per driver for hazardous materials only or $8 per driver for transporting passengers only.

North Idaho College

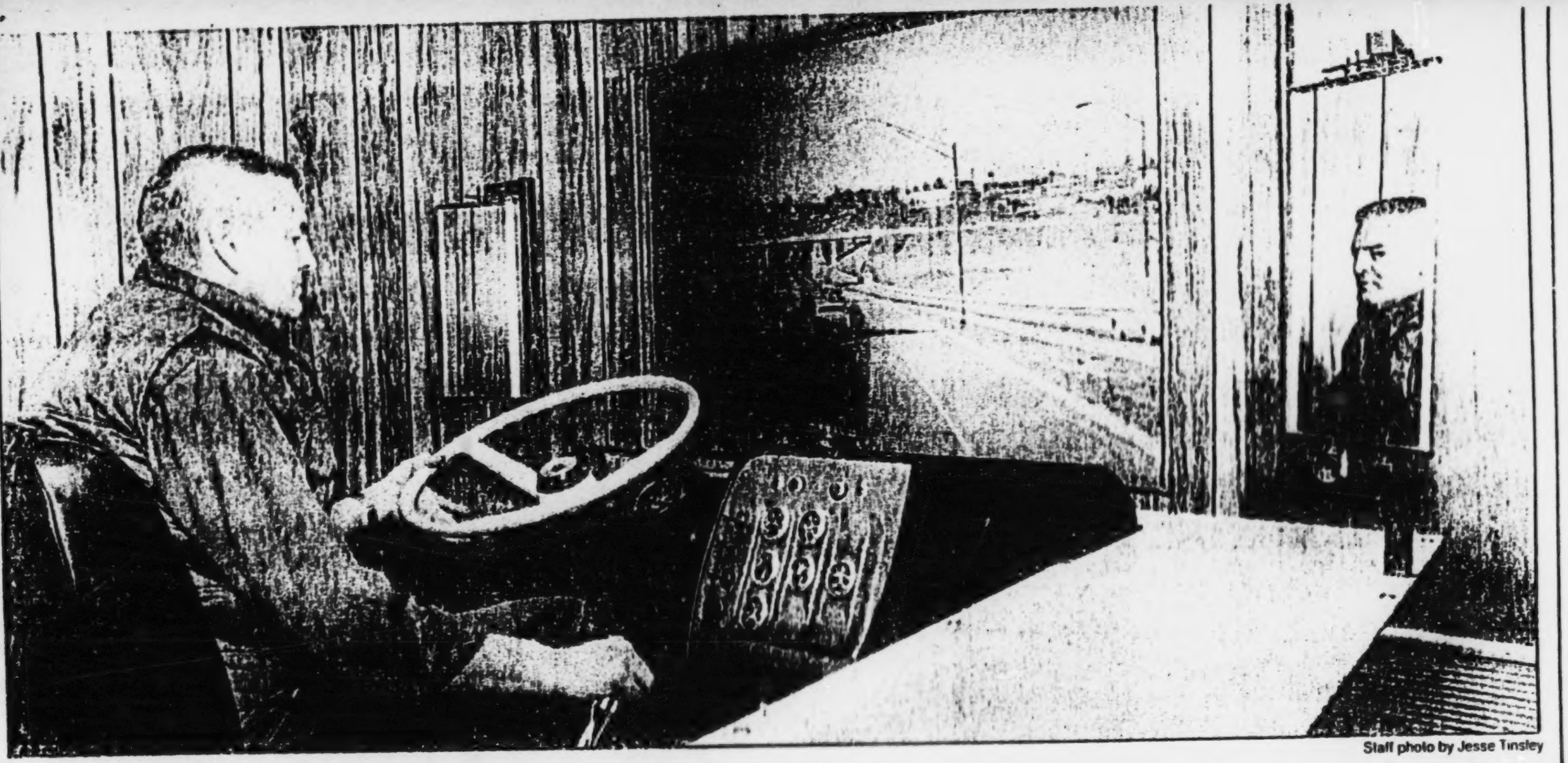
TRUCK DRIVER SKILL ASSESSMENT AND UPGRADE TRAINING

Instructor Riley Scott will be at North Idaho College November 7 thru 28 with a truck driving simulator mounted in a semi-trailer. Riley is bringing the unit up from Boise to provide testing and training for North Idaho truck drivers employed in the mining and construction industry.

A $15 fee includes both a written exam and a road test to comply with new regulations requiring employers to administer these tests for individual employee qualification files. This is in addition to the new federal and state Commercial Driver License (CDL) requirements. Because of these new requirements, the USDOT federal safety regulations will be enforced for intrastate as well as interstate truck drivers and motor carriers.

The emphasis of this program is on setting up driver qualification files for employers in accordance with the USDOT federal safety regulations. This will also facilitate acquiring the new state Commercial Drivers License (CDL).

An estimated 2 hours per driver will be involved. Call 769/3436 for additional information or to schedule appointments. On-site service can be arranged for six or more drivers.



Staff photo by Jesse Tinsley

North Idaho College instructor Gene Soper puts a truck-driving simulator through its paces.

Trucker-licensing program gets in gear at NIC

By Cynthia Taggart
Staff writer

COEUR d'ALENE — Gene Soper downshifted his semi-truck and peered into his rearview mirror.

"I don't like that Volkswagen getting so close to me," he said, as the driver of the little car searched for a way around Soper's truck. "That Volkswagen is giving me all kinds of trouble."

Before Soper could complain more, the highway and offending car disappeared and white light filled the truck's two rearview mirrors and [illegible]. The motor quieted and the red [illegible] the dashboard faded.

"I guess you know how to drive," J. Riley Scott said with a laugh, as Soper climbed from behind the wheel on the truck simulator parked at North Idaho College.

Scott is a federal trucking safety regulations certifier hired by NIC with a grant from the state Department of Vocational Education. Through Nov. 28, he will help Panhandle truckers compile the paperwork they'll need to qualify for a new state commercial-driver license that most truck drivers must have by April 1992.

Starting in 1992, all drivers of trucks that weigh 26,001 pounds or more, carry 16 or more people or transport hazardous materials must carry commercial-driver licenses.

The licenses, which will be available in April, will show that the drivers meet federal Department of Transportation highway safety regulations. Because drivers must meet federal requirements to earn the license, all states will issue the same license, Scott said.

The Transportation Department created the new licensing program to halt some truckers' use of licenses from several states, Scott said. For example, some truckers have [illegible] up traffic violations on licenses from [illegible] or Montana, but continue to drive using a violation-free license from another state, he said.

Under new licensing regulations, drivers now face fines of up to $2,500 for carrying more than one license.

For interstate trucking companies, compliance with federal safety regulations is nothing new. But enforcement of the federal regulations on intrastate truckers has been lax, Scott said.

Most independent truckers and small contractors will need refresher courses to meet the requirements for the new commercial-driver license, he said.

Please s[illegible]UCK: B3

TINUED: FROM B1

Truck

To qualify for the new license, truckers will need employment files with documents attesting employment, knowledge and understanding of the federal regulations, good physical health and good driving records.

Owners of trucking companies will provide most of the paperwork for their employees. Scott will help compile the files for independent truckers, who can't road test themselves.

During his stay at NIC, Scott will give written, open-book exams on the federal regulations manual. He'll also conduct road tests, but drivers must supply their own rigs. NIC will charge drivers $15 for the service, which will include practice time on the simulator.

When drivers apply for the new licenses with the state, they'll take another written test and road test in addition to the ones contained in their employment files.

For information on NIC's program, call 769-3436.

STATE OF IDAHO
STATE DIVISION OF VOCATIONAL EDUCATION
LEN B. JORDAN BUILDING
650 W. STATE ST. **BOISE, IDAHO 83720**

May 31, 1989

MEMORANDUM

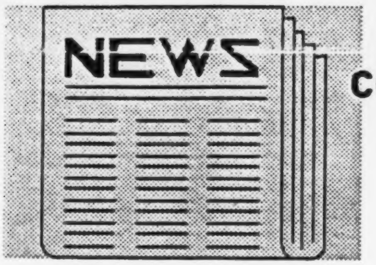
TO: Flagging Instructors

FROM: Don Owen
Statewide Construction Specialist

SUBJECT: Flagging Guidelines

The following guidelines are to be used when conducting flagging programs:

1. Have students evaluate each class. Use only the Cooperative Demonstration evaluation format in order to meet the federal evaluation requirements.
2. The basic format of the program must follow the guidelines originally established by the State Division of Vocational Education and the state personnel from the Idaho Transportation department. That format provides for approximately six hours of classroom and hands-on training.
3. Make sure each student is given a copy of the training manual for their personal copy to take with them.
4. The target size of the class is between 12 to 15 students. Do not exceed a maximum of 20 students per class.
5. Report all classes conducted. Submit student evaluation forms for head count under the construction grant.
6. The state fee is $20.00. Ten dollars for registration fee for recordkeeping and ten dollars to be used for in-kind match on the grant.
7. Report all students that have successfully completed the program to your Idaho Transportation Department and to the Short-Term Training Coordinator at your postsecondary vocational-technical school. This includes name, issue date, card number, and test score. Retain all tests until the information has been reported to those two sources.
8. Schools that provide the training will also issue any replacement cards for those cards that are lost or destroyed.
9. Posters advertising the program will be placed by each postsecondary vocational-technical school in their local Department of Employment.
10. All funds generated by grants must be spent in that program or given back to the federal government. For specifics check the school copy of (EDGAR) Education Department General Administrative Regulations.



COOPERATIVE DEMONSTRATION GRANT

PROJECT UPDATE

MAY, 1989

Five months into the grant and there are lots of happenings around the State. This newsletter is being distributed to bring everyone up to date on current projects and future plans in each region.

REGION I

North Idaho College has two programs currently running for the mining industry. The diamond drilling class has six participants; the mining class has 18. The 33 students who completed the last two mining classes have a 90% placement rate. It is felt that this class will fulfill the hiring requirements for that area.

North Idaho College has run 6 flagging classes to date and has issued 74 cards. They have five more classes scheduled.

REGION II

Keith at Lewis-Clark State College has run 2 classes certifying about 24 flaggers. They still have 20-25 on their list awaiting classes. Keith is in the process of scheduling a Basic Architectural Blueprint Reading class. This is in direct response to the results of his contractor's survey. He reported a 50% return on that survey. The most frequently sighted needs were: Blueprint Reading; First-Aid; and Supervision.

REGION III

Don Owen has conducted 12 flagging classes certifying 140 flaggers. Four more classes are scheduled for this spring. In addition, Don has a subproposal approved for a Heavy Equipment Operators class to assist contractor's in their EEO Compliance needs. That class will accommodate 12 students and will be scheduled after July 1.

There are also two construction truck driving classes in the works for this summer. Those classes will train 10 - 12 students per class using a truck driving simulator and back end dump trucks and belly dump trucks.

Don also has a concrete seminar scheduled for November. BSU has a State of Idaho Safety and Health Consultation Program in place that provides safety and health surveys for all Idaho commercial and industrial employers at no financial charge. The program provides:

- a model hazard communication program
- ergonomics evaluations
- safety surveys
- electrical safety surveys
- air contaminant surveys
- sound and noise surveys
- ventilation surveys
- life safety surveys
- safety and health management assistance
- audio-visual resource training library

This Safety and Health Consultation Program has two industrial hygienists and one safety expert. They are available to any contractor in Idaho.

COOPERATIVE DEMONSTRATION PROGRAM IN CONSTRUCTION AND MINING

Cooperative Work Agreement

Between

Idaho State Division of Vocational Education

and

School of Vocational-Technical Education
Boise State University

Purpose

The purposes of the agreement are: to define responsibilities of Construction Specialist/Apprentice Coordinator concerning statewide activities for the Cooperative Demonstration Program in Construction and Mining; to define responsibilities of Construction Specialist/Apprentice Coordinator concerning Boise State University service delivery area activities for the Cooperative Demonstration Program in Construction and Mining; to define role of State Division of Vocational Education and to define role of the School of Vocational-Technical Education, Boise State University.

Responsibilities

The responsibilities of the Construction Specialist/Apprentice Coordinator concerning statewide activities for the Cooperative Demonstration Program in Construction and Mining include but are not limited to the following:

- Provide consultation and training to the regional postsecondary coordinators/instructors for the project.
- Develop statewide linkages with private and public organizations and provide direction and processes to use to contact these agencies.
- Establish construction and mining curriculum to be housed in the state office and assist coordinators in the development of needed curriculum
- Gather, review, organize and submit all data to the appropriate project administrators for evaluation and future dissemination.
- Periodically survey contractors' associations to determine needs to meet labor demands in the industry, and provide information to coordinators as appropriate.

The responsibilities of the Construction Specialist/Apprentice Coordinator concerning local activities coordinated through the School of Vocational-Technical Education, Boise State University include but are not limited to the following:

- Conduct construction needs assessments within the institutions' service delivery area.
- Establish construction advisory committees when appropriate.
- Coordinate programs with area private and public organizations.
- Establish, and in some cases teach related instructors for apprentices, specialized training for journeymen upgrading. Act as a resource person in safety for the institution.
- Develop and submit subproposals for funding under this grant.
- Coordinate the use of facilities and instructors and recruitment of students for approved construction programs.
- Maintain data for the evaluation and future dissemination of the program.
- Perform job site follow-up on any apprenticeship programs developed where apprentices are in an OJT program.
- Act as a public relations proponent for job entry into the construction industry.

The State Division of Vocational Education will:

- Provide facilities including telephone to be utilized by Statewide Construction Specialist/Apprentice Coordinator during period of grant.
- Provide clerical services in support of statewide activities through the grant.
- Provide statewide grants management.
- Provide for dissemination of curriculum developed through grant.
- Provide for overall evaluation and summary of grant activities.

The School of Vocational-Technical Education, Boise State University will:

- Provide facilities including telephone to be utilized by Construction Specialist/Apprentice Coordinator during period of grant.
- Provide clerical services in support of the service delivery area activities developed through the grant.
- Provide fiscal record keeping for Construction Specialist/Apprentice Coordinator as specified in grant.

This cooperative work agreement is entered into by the Idaho State Division of Vocational Education and the school of Vocational-Technical Education, Boise State University, to fulfill the obligations of the Cooperative Demonstration Program in Construction and Mining, and may be modified or amended as necessary by either party with a 30-day notification, one to the other.

School of Vocational-Technical Education
Boise State University

Date

Acting State Administrator
State Division of Vocational Education

Date

DW:nw

MEMORANDUM OF AGREEMENT

IDAHO TRANSPORTATION DEPARTMENT (ITD)

STATE DIVISION OF VOCATIONAL EDUCATION (SDVE)

The SDVE and ITD are in mutual agreement in conducting the Flagging/Basic Traffic Control Program as a joint effort. This agreement will be subject to a yearly review by both parties, and will automatically be renewed on July 1 of each year unless termination is requested by either party at least 30 days in advance. The following guidelines are supported by both parties. Each postsecondary vocational-technical school and each ITD District will follow these guidelines and adhere to the Manual on Uniform Traffic Control Devices (MUTCD).

1. Programs will be conducted at each of the six postsecondary vocational-technical schools.

2. ITD Safety Coordinators or Traffic personnel will have the latitude to periodically monitor classes for content and presentation.

3. Instructors are certified by ITD Headquarter's Safety Office after attending the authorized "Flagging Instructor Course" taught by an ITD representative or SDVE Flagging Course instructor.

4. The attached basic training format will be followed by all instructors. The format provides for six hours of classroom and hands-on training in both flagging and basic traffic control.

5. District ITD offices will provide the videos, ITD flagger's booklet, charts on standard traffic signs and flagging certification cards.

6. SDVE will provide each student with a copy of the training manual for them to keep. This manual will include Chapter 6 of the MUTCD.

7. Each postsecondary school shall have the latitude to establish a registration fee. This fee will be made as economical as possible to the participants.

8. Each school will be responsible for maintaining records, and will also issue any replacement cards for those cards lost or stolen.

9. A normal class size will be 15 students. Maximum class size will be 20 students. Classes with less than 15 students may be conducted at the discretion of the vocational-technical school.

(Continued)

10. The final test will consist of at least 50 questions. A minimum passing score on the test will be 75%.

11. Students will evaluate each class. Evaluation forms will be kept on file at each institution.

SIGNATURES:

IDAHO TRANSPORTATION DEPARTMENT

6/11/90
Date

STATE DIVISION OF VOCATIONAL EDUCATION

6-13-90
Date

APPROVED AS TO FORM:

PURPOSE and POLICY

Parties signatory to the following Standards of Apprenticeship declare their purpose and policy to be that of establishing and sponsoring an organized system of apprenticeship training. The Standards are in conformity with Federal Labor Standards (29 CFR 29), which govern employment and training in apprenticeable occupations.

DEFINITIONS

Apprentice shall mean a person at least sixteen (16) years of age, who has signed a written Apprenticeship Agreement with a Sponsor to learn an apprenticeable occupation, as outlined in these Standards.

Journeyman shall mean an individual who has sufficient skills and knowledge of a trade, craft, or occupation, either through formal apprenticeship training or through practical on-the-job work experience, to be recognized by a State or Federal registration agency and/or an industry as being fully qualified to perform the work of the trade, craft, or occupation.

Apprenticeship Agreement shall mean a written agreement between an apprentice and the Sponsor, which has been registered with the registration agency.

Sponsor shall mean any person, plant, firm, facility, or organization operating an apprenticeship program and in whose name the program is (or is to be) registered, or approved.

Standards shall mean this entire document, including Addenda, containing specific provisions for operation and administration of the apprenticeship program.

Registration agency shall mean the Bureau of Apprenticeship and Training, U.S. Department of Labor.

SPONSOR RESPONSIBILITIES

The Sponsor shall take necessary steps to rotate the apprentice(s) in the various work processes of the skilled occupation and will require the apprentice(s) to make satisfactory progress in both on-the-job and related instruction, to assure a well rounded, competent worker. The Sponsor shall ensure the apprentice works under and with competent workers skilled in the occupation for which the apprentice(s) is being trained. Adequate training records will be maintained, to show the progress of the apprentice(s) during the full term of apprenticeship.

APPRENTICE WAGES and WAGE PROGRESSION

A progressively increasing schedule of wages shall be paid to the apprentice, consistent with the skill acquired. The entry wage shall be not less than the minimum wage prescribed by the Fair Labor Standards Act, where applicable, unless a higher wage is required by other applicable Federal law, State law, respective regulations, or by collective bargaining agreement.

A progressively increasing schedule of wages, in percentages, is recommended, indicated in hours or monthly periods to be set by the Sponsor. (See Addendum)

PERIODIC REVIEW, EVALUATION and MAINTENANCE of PROGRESS RECORDS

It shall be the duty of the Sponsor to periodically review and evaluate apprentices, before advancement to their next progression period. The basic evidence of such advancement shall be the record of the apprentice's progress on the job and during related instruction. If such progress is not satisfactory, the Sponsor shall have the right to withhold their periodic wage advancements, suspend or revoke the Apprenticeship Agreement, or make such recommendations it feels desirable. A recordkeeping system shall be established by the Sponsor for such purposes.

RATIO of APPRENTICES

As determined by the Sponsor, a numeric ratio of apprentices to journeymen shall be included in these Standards. It shall be consistent with proper supervision, training, safety, continuity of employment, and applicable provisions in collective bargaining agreement, if any; EXCEPT where such ratios are expressly prohibited by collective bargaining agreement. The ratio language shall be specific and clear as to application in terms of job site, work force, department or plant. Reasonable exceptions to the ratio may be made, at the discretion of the Sponsor. (See Addendum)

PROBATIONARY PERIOD

All apprentices are subject to a probationary period (to be determined as reasonable to the full apprenticeship term), for which they shall receive full credit toward completion of apprenticeship. (See Addendum) During the probationary period, the Apprenticeship Agreement may be terminated by either the Sponsor or apprentice, without the formality of a hearing or stated cause. After the probationary period, the apprentice may be cancelled for causes deemed adequate and so indicated to the registration agency.

SUPERVISION of APPRENTICES

The Sponsor shall assure that apprentices are under the supervision of competent and qualified journeymen on the job, so as to ensure training in all phases of the work. Apprentices shall work the same hours as journeymen, EXCEPT where such hours may interfere with related instruction classes.

CERTIFICATE of COMPLETION

Upon successful completion of apprenticeship, as set forth in these Standards, and passing such examination as the Sponsor may require, Sponsor shall recommend that the registration agency issue a Certificate of Completion of Apprenticeship.

MODIFICATION, CANCELLATION and DEREGISTRATION of PROGRAM

These Standards may be modified or changed, for the betterment of the apprenticeship system, by submitting proposed modification(s) or change(s), in writing, to the registration agency, for approval. If approved, they shall be recorded and acknowledged as an amendment to the program. HOWEVER, such modification(s) or change(s) shall not affect Apprenticeship Agreements then in force, without consent of all parties signatory to the Agreement.

Cancellation and deregistration of the program may be accomplished voluntarily, by a written request from the Sponsor to the registration agency, or by formal deregistration proceedings, under reasonable cause, by the registration agency instituting formal deregistration proceedings in accordance with the provisions of 29 CFR 29.7.

EQUAL EMPLOYMENT OPPORTUNITY in APPRENTICESHIP and TRAINING

Each Sponsor establishing an apprenticeship program under these Standards hereby includes, as part of these Standards, the following Equal Employment Opportunity Pledge:

> *The recruitment, selection, employment and training of apprentices during their apprenticeship shall be without discrimination because of race, color, religion, national origin or sex. The Sponsor shall take affirmative action to provide equal opportunity in apprenticeship and will operate the apprenticeship program as required by Title 29 Part 30 of the CODE OF FEDERAL LABOR STANDARDS.*

Each Sponsor, when applicable (Sponsors with five (5) or more apprentices in any

TRAINING COORDINATOR - TRAINING DIRECTOR

Sponsor may employ a competent person as a full or part time Training Coordinator/Training Director. Such person shall assume responsibilities and authority for the operation of the program as are delegated by the Sponsor.

CONSULTANTS

Consultants may be asked to participate, without vote, in conferences related to apprenticeship.

ADDENDUM (INJ) *

PROBATIONARY PERIOD

All apprentices employed in accordance with these Standards shall be subject to a probationary period not exceeding the first 2,000 hours of the term of apprenticeship.

MINIMUM QUALIFICATIONS

Apprenticeship applicants, before being considered as apprentices, must meet the following: (only checked items apply)

☒ Must be between the ages of 18 and N/A. Exceptions may be made by the Sponsor for those above the age limit, who have creditable experience in the occupation and/or have been in military service. Such exception for military service shall not exceed ______ additional years.

☐ Have a ______ grade education or certified equivalency.

☐ Must have taken and passed all phases of a validated specific aptitude test for the occupation, administered by the local State Employment Service office.

☒ Be physically fit, without regard to any occupationally irrelevant physical handicap.

☐ Other ______________________________

____

____

---

* For each skilled occupational objective listed, include separate attachments: Attachment #1 - TERM of APPRENTICESHIP; APPRENTICE WAGES and WAGE PROGRESSION; RATIO of APPRENTICES; Attachment #2 - WORK PROCESSES

ADDENDUM (INU)
Attachment #1

Skilled occupational objective: MINER

TERM of APPRENTICESHIP

The term of apprenticeship shall not be less than 2,000 hours of reasonably continuous employment.

APPRENTICE WAGES and WAGE PROGRESSION

Apprentices shall be paid based upon the following percentages of the journeyman wage rate:

1st ______	period	____%	6th ______	period	____%
2nd ______	period	____%	7th ______	period	____%
3rd ______	period	____%	8th ______	period	____%
4th ______	period	____%	9th ______	period	____%
5th ______	period	____%	10th ______	period	____%

As of ______ (date), the journeyman wage rate for this skilled occupation

is $ ______ per ______. Should this wage rate be increased during the term of apprenticeship, adjustments in apprentice wages shall be made to reflect stated percentages of the higher journeyman wage rate.

RATIO of APPRENTICES

For 1 (number) journeymen regularly employed, employer ☒ may ☐ shall have

1 (number) apprentice(s) and ☒ may ☐ shall have 1 additional appren-

tice(s) for each 3 (number) journeyman regularly employed thereafter.

939.281-010
0354 AMS

ADDENDUM (INJ)
Attachment #2

Skilled occupational objective: Miner I

WORK PROCESSES*

During the term of apprenticeship, the apprentice shall receive such instruction and experience, in all branches of the occupation, as are necessary to develop a practical and versatile worker. Major processes in which apprentices will be trained (although not necessarily in the order listed) and approximate hours (not necessarily continuous) to be spent in each are as follows:

WORK PROCESSES	APPROXIMATE HOURS
A. JACKLEG DRILLING	750
B. ROCK BOLTING	400
C. TIMBERING	100
D. MUCKING MACHINE	500
E. TRACK REPAIR	50
F. DRIFTING	50
G. SLUSHER	50
H. BALD RAISES	75
I. MACHINERY MAINTENANCE	25

TOTAL HOURS 2,000

* Use additional sheets, if necessary

ADOPTED and APPROVED:

For the Sponsor/Employer

By __________________________

Title __________________________

Date __________________________

Registered as incorporating the basic
fundamentals recommended by the
Federal Committee on Apprenticeship

By __________________________

Title Regional Director

Date __________________________

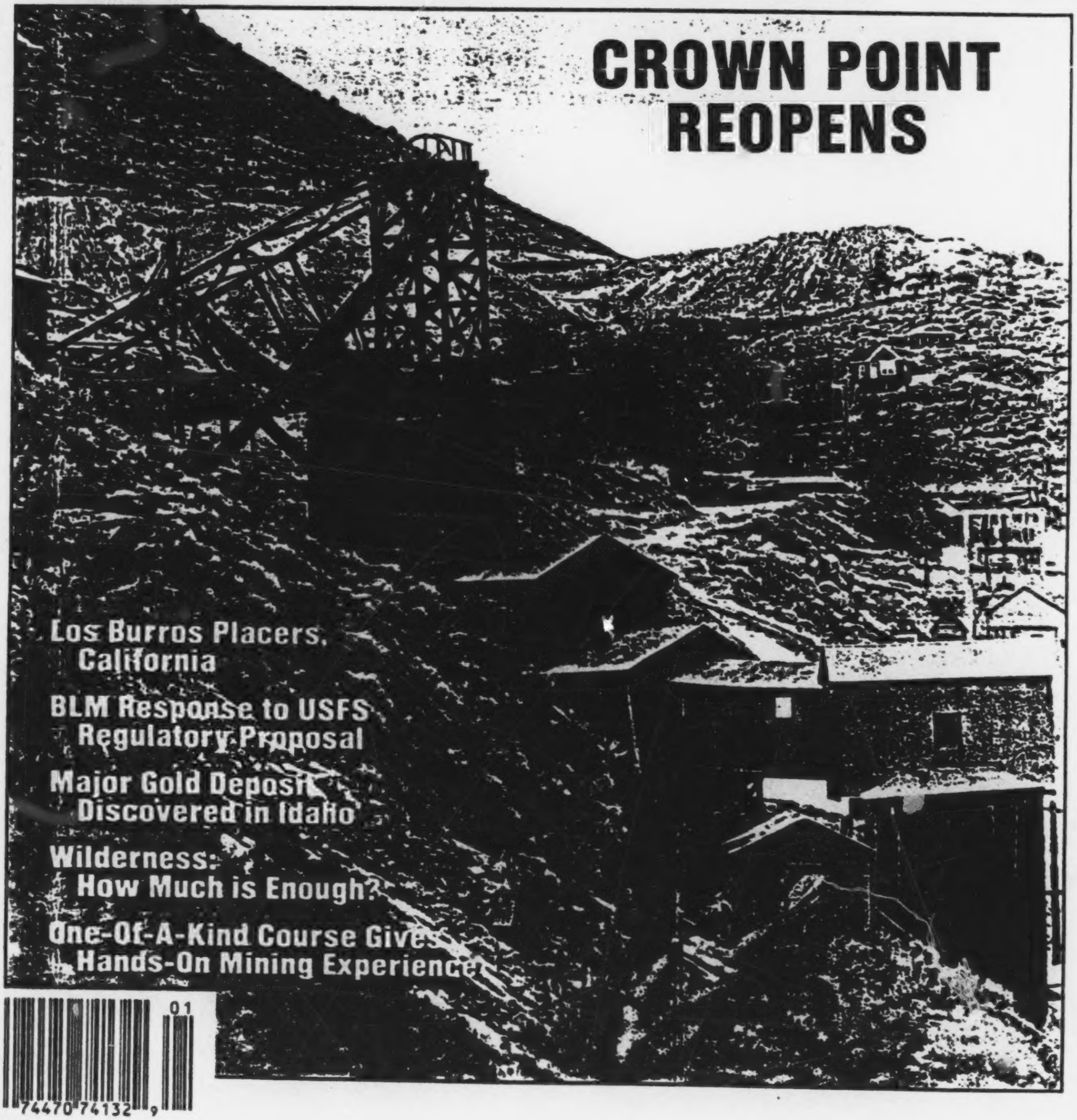
Joseph J. Harris
Apprenticeship and Training Representative
Bureau of Apprenticeship and Training
U. S. Department of Labor
Boise, Idaho

AROUND [illegible]

Volume 58, Number 5
JANUARY 1989
$2.00
$3.00 Canada

California MINING JOURNAL

THE WEST'S LEADING DOMESTIC MINING PUBLICATION



CROWN POINT REOPENS

Los Burros Placers, California

BLM Response to USFS Regulatory Proposal

Major Gold Deposit Discovered in Idaho

Wilderness: How Much is Enough?

One-Of-A-Kind Course Gives Hands-On Mining Experience

01
0 74470 74132 9

One-Of-A-Kind Course Gives Hands-On Mining Experience

by David Bond

Mullan, Idaho—Students at the nation's only hard-rock mining school have found more than just hope for a new profession in northern Idaho's Silver Valley.

Breaking rock recently in their "underground classroom" at the Atlas Mine near Mullan, they also found silver.

"Take a look at this. That's good ore," beamed Lovon Fausett, Sr., president of Fausett International, a Wallace mine-building company.

He helped organize the course through North Idaho College.

"Mining companies have spent millions trying to find ore in this mine, and then these kids come along and do it," said Fausett, a handful of galena ore samples glistening in the light of his mine lamp.

The find was small, a few "stringers" of lead and silver ore peeking through an otherwise barren quartz vein just a short distance from the main tunnel. But the lesson for the 30 young men learning to mine was real: Ore can sneak up on you in the strangest places.

It was enough to pique the interest of the students, who told their instructor and shift boss, Al Wattula, that they wanted to skip lunch, stay underground and drill another round that day.

Instructors are miners like Wattula, who supervised construction of the No. 12 Shaft at the Sunshine Mine before being laid off in 1982. They have an average of 25 years mining experience.

Bernie Knapp, North Idaho College vocational instructor and director of the new mining school, said more applicants were turned away than were accepted for the 30 openings in the class.

Applicants were given intelligence tests, then screened by a panel of mine supervisors from the Silver Valley.

"We want people that want to work. This isn't a welfare program," Knapp said. "It's three months of hard work, 40 hours a week, with no pay."

The first session of the three-month course began in early November; Knapp said he has obtained enough state and vocational grant money to run the school for 18 months.

Wallace High School closed its mining class when the mining recession rolled through northern Idaho in 1981. There seemed little point in training new miners when 1,000 experienced rock breakers were out of work, and the Sunshine, Bunker Hill, Star and Lucky Friday mines closed.

Most of the Silver Valley's big mines have now reopened, thanks to an upturn in lead and zinc prices and in anticipation of a rise in silver prices next year.

"We've come full circle," Knapp said. "I've spent the last 10 years retraining miners to do something else. Now we're training miners again."

Even with reopenings at the Bunker Hill, Lucky Friday and Sunshine mines, companies have not flung their doors wide to new hires. Most employees at the mines now have been former workers with experience and union recall rights.

As a result, the work force is both graying and green. The industry went through an eight-year recession without training new workers, and many skilled miners found new lines of work.

Bunker Hill Mining Co. President Jack Kendrick said about one-fourth of the rock-breakers hired at Bunker Hill since its reopening in May had no previous underground experience.

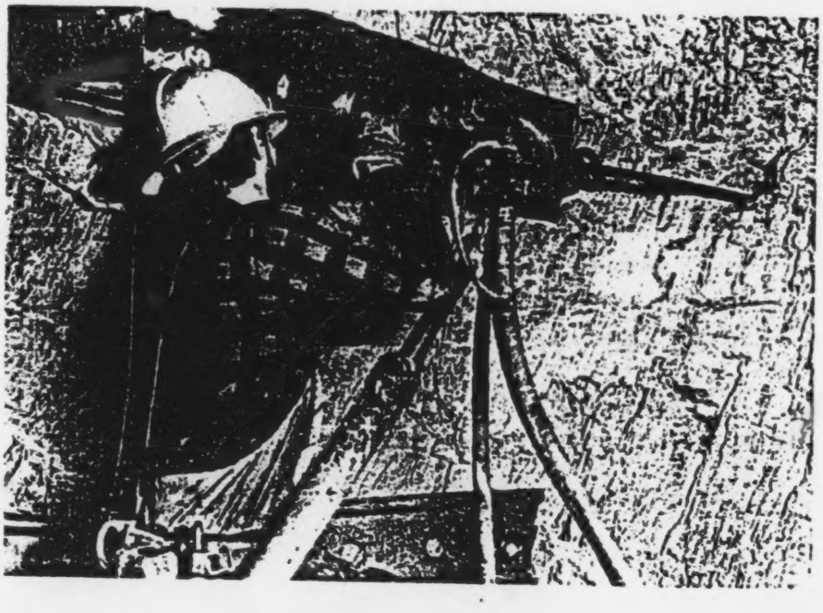
Bunker Hill, Sunshine Mining co., Atlas Mine and Mill Supply and Fausett International have donated about $80,000 worth of used equipment and new material to give the students hands-on mining experience. Also participating is the United Steelworkers of America union, which represents most of the West's hard-rock miners.

"Without help from the mines this class would not be possible," Knapp said.

While some of the student's hours are spent above-ground in a small classroom where they learn the paperwork of mining, most of the course's 480 hours are spent in the shafts.

Miners advance headings in the rock—drilling a pattern of holes in the rock's face, blasting, removing the blasted rock, shoring up the excavation and preparing the area for another round.

"Rock breakers" need a variety of skills ranging from a knowledge of rock mechanics to carpentry to perform their daily chores, as well as a good grasp of safety, Fausett said.



Student drills a round at Atlas mine.

"Day's pay" workers, on the other hand, operate trains or perform more conventional tasks underground.

"People think of mining as pick-and-shovel work," Knapp said. "It's not. It's a highly mechanized, highly specialized business. It's changed a lot over the years."

Fausett said graduates will be able to hold their own with an experienced partner. "Every kid in here will have drilled and blasted a round before he's through," he said. "This is run right."

Many of the students, all males, mostly in their 20s for the first session, are learning how to mine for the same reason.

"Mining companies have spent millions trying to find ore in this mine, and then these kids come along and do it."

STATE OF IDAHO
Cecil D. Andrus, Governor
TRANSPORTATION DEPARTMENT
P.O. BOX 7129 • BOISE, ID • 83707-1129 • 208/334-8000

October 1989

Dear Motor Carrier:

Beginning in April 1990, Idaho will begin implementing the new Commercial Driver's License (CDL) program to comply with federal requirements. This program will change the way Idaho drivers of buses and heavy trucks are tested and licensed. All drivers of these vehicles must be made aware of the significant changes that will affect them.

As a driver or employer of drivers, we know you are concerned about the manner in which the new CDL program will affect you and that you are interested in seeing this program implemented smoothly. Enclosed are several items of information about the CDL program to help you prepare for the transition to this new licensing system. This information may also be helpful to you in answering questions from your drivers about the CDL.

An area of special concern is locating companies that wish to become involved in the program as "third party testers." Because neither the state nor the county sheriffs' offices have the resources or facilities required to administer the skills tests, the state will contract with third parties (private industry and/or other public agencies) to administer them. One of the enclosures is a fact sheet with some basic information about the third-party testing program and a short survey/response card. If you are interested in becoming a third-party tester, please complete and return the survey card. Additional information can then be sent to you.

Also enclosed is a CDL brochure, available from the Idaho Transportation Department or your county sheriff's office. You may wish to obtain a supply of these brochures for your drivers.

Thank you for your interest and cooperation. Your assistance is essential to the successful implementation of this program. If you have any questions, please feel free to call the CDL Information Hotline (1-800-344-3941), or Richard Holloran, CDL Coordinator, at (208) 334-8744.

Sincerely,

DOUGLAS L. KRAEMER
Chief of Motor Vehicles

DLK:RH:ad

Celebrate IDAHO
1890 • CENTENNIAL • 1990

CDL FACT SHEET

Beginning in April 1990, Idaho will change the way drivers of buses and heavy trucks are tested and licensed. If you are a driver or employ drivers that operate the following vehicles, you and your drivers need to be aware of these changes.

- Any vehicle with a Gross Vehicle Weight Rating (GVWR) over 26,000 pounds.
- Any vehicle designed to carry 16 or more persons, including the driver, regardless of weight.
- Any vehicle carrying placardable quantities of hazardous materials, regardless of weight.

Note: The Gross Vehicle Weight Rating is the manufacturers rating assigned to the vehicle.

Drivers who operate any of the above vehicles are considered "Commercial" Drivers and must comply with this new program. By April 1, 1992, all Commercial Drivers must obtain a new license called a Commercial Driver's License or CDL.

Beginning April 1, 1990, operator and chauffeur licenses will no longer be issued in Idaho but will remain valid for driving the types of vehicles listed above until April 1, 1992, or until they expire, whichever comes first. Operator and chauffeur licenses will, however, remain valid for driving light vehicles, such as passenger cars and pickups, until they expire.

The new CDL will show the class of vehicle a driver may operate and any special endorsements for which the driver has qualified. The new classes, endorsements, and restrictions are listed below.

CLASS "A" - Combination vehicles with a combined GVWR over 26,000 pounds and the GVWR of the vehicle(s) being towed is over 10,000 pounds.

CLASS "B" - Single vehicles with a GVWR over 26,000 pounds. These vehicles may also tow trailers with a GVWR of 10,000 pounds or less.

CLASS "C" - Any vehicle with a GVWR less than 26,001 pounds if:

- designed to carry 16 or more persons, including the driver, or
- transporting placardable quantities of hazardous materials.

ENDORSEMENT "T" - Required when operating a double or triple trailer combination unit.

ENDORSEMENT "P" - Required when operating a passenger vehicle designed to carry 16 or more persons, including the driver.

ENDORSEMENT "N" - Required when operating a tank vehicle designed to carry liquid or gas.

ENDORSEMENT "H" - Required when operating a vehicle carrying placardable quantities of hazardous material.

RESTRICTION "K" - Restricts operators to operating vehicles without air brakes.

Prior to issuing the new CDL, the licensing office will:

- Conduct a local and national driver's record check,
- Require the driver to pass the required knowledge (written) test(s), and
- Require the driver to either pass the skill (road) test or to meet minimum standards for waiver of the skill test.

ALL DRIVERS MUST TAKE THE KNOWLEDGE TEST(S): A driver may take from one to six written tests depending on the endorsements requested. To accomplish most of the knowledge testing, group testing in association with the county sheriffs' offices in some areas of the state will be implemented. Under this group testing program, drivers will take the required written tests at a specified time and place along with other drivers obtaining the CDL. Sheriffs will be given the latitude to decide how much of the written testing they wish to conduct in the limited space available in most licensing offices.

- over -

67

Who must comply with the U.S. DOT Safety Regulations?

Many truck and bus operations are subject to some or all of the DOT safety regulations.

Listed below are three principal regulatory areas and the types of truck and bus operations covered by each. This list provides only a summary of these three regulatory areas. For more detailed information, the Federal Motor Carrier Safety Regulations (Title 49, Parts 200-399) should be consulted. The regulations can be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, phone (202) 783-3238. They are also available (often more up to date and less expensive) from a number of commercial sources.

The "Definitions and References" section should be used to interpret the underlined words.

1

The Federal Motor Carrier Safety Regulations (FMCSR) apply to your operation(s) if:

You operate a commercial motor vehicle to transport property or passengers in interstate commerce.

EXCEPTION: The FMCSR do not apply to the private transportation of passengers but only to the for-hire transportation of passengers.

2

The **Hazardous Materials Regulations** (HMR) apply to your operation(s) if you operate a motor vehicle of any size to:

a. transport a hazardous material in interstate commerce, or

b. transport, wholly within one State or in interstate commerce, the following:

(i) a hazardous waste or hazardous substance, whether in bulk or not, or

(ii) a flammable cryogenic liquid in bulk.

3

The **Minimum Financial Responsibility (Insurance) Requirements** apply to your operation(s) if:

a. you are a for-hire motor carrier of property or passengers in interstate commerce, or

b. you operate a motor vehicle to transport any quantity of a hazardous material in interstate commerce, or

c. you operate a motor vehicle to transport a hazardous material in bulk wholly within one State or in interstate commerce.

EXCEPTION: The Financial Responsibility (Insurance) Requirements do not apply to trucks with a gross vehicle weight rating (GVWR) under 10,000 pounds (unless transporting Class A or B explosives, poison gas, or highway route controlled radioactive materials), school buses, taxicabs, or van pools.

Definitions and References

1. The Federal Motor Carrier Safety Regulations (FMCSR) are found at 49 CFR Parts 350-399.

2. A "commercial motor vehicle" is:

(a) a truck with a GVWR over 10,000 pounds, or

(b) a truck of any GVWR that is used to transport a hazardous material in a quantity requiring placarding, or

(c) a bus designed to transport more than 15 persons, including the driver.

3. "Interstate commerce" means across State lines, including international boundaries, or wholly within one State as part of a through movement that originates or terminates in another State or country.

4. A "for-hire motor carrier" is a transporter of property or passengers by motor vehicle for compensation and is more specifically defined in 49 CFR Sections 387.5 (property) and 387.29 (passengers).

5. The Hazardous Materials Regulations (HMR) are found at 49 CFR Parts 171-179.

6. "Hazardous materials" and "hazardous wastes" are listed in the Hazardous Materials Table in 49 CFR Section 172.101. "Hazardous substances" are listed in an appendix to that Table.

7. A "cryogenic liquid" is a refrigerated liquefied gas having a boiling point colder than −130 °F (−90 °C) at one atmosphere, absolute (49 CFR Section 173.300(f)).

8. "In bulk" is defined as the transportation of any property in a portable or cargo tank with a capacity in excess of 3,500 gallons.

EXCEPTION: Transportation of any quantity of Class A and B explosives or poison gases is defined as "in bulk" (49 CFR Section 387.5).

9. The Minimum Levels of Financial Responsibility (Insurance) Requirements are part of the FMCSR and are found at 49 CFR Part 387. They state, in part, that proof of the required financial responsibility (insurance) shall be maintained at the motor carrier's principal place of business, usually on a Form MCS-90 (property) or MCS-90B (passengers), issued by an insurer, although there are other acceptable forms of proof as explained in full in the regulation. Foreign carriers are required to maintain a copy of the MCS-90 on board the vehicle when operating in the United States.

For further information, contact the Office of Motor Carrier Safety in the Federal Highway Administration office in your State (see list on the back of the pamphlet).

February 1989

Curriculum

The qualification forms include:

1. Application for employment
2. Violations and review record
3. DOT written examination
4. Certification of road test
5. DOT physical examination form
6. Inquiry to past employer
7. Record of road test
8. Driver data sheet
9. Road test certification
10. Certification of qualification
11. Federal motor carrier regulations ($3.00 each)

Each participant will be supplied with the necessary forms. These are to be completed and given to their employer.

Most forms can be completed in class, while other forms such as the physical examination form must be completed at a later time with a physician.

Simulator

Each participant will spend up to 45 minutes on the simulator. The instructor's console is situated behind the driver. As the driver performs his driving activities, the instructor can insert malfunctions into the console and evaluate the driver's response to various situations.

The driver has a screen in front of him with a video program that depicts roads and traffic conditions. After a few minutes practice the driver is expected to perform appropriately with shifting and responses in the change of road conditions on the screen.

The I.S.C. - Teamsters Training Truck Simulator:

One of the ways we can accomplish the goals of this training program is the utilization of our truck simulator, which represents an investment of $105,000.00.

The simulator is a training aid with a varied application in truck driver screening and training. The simulator can be used to screen applicants for driver training or driving jobs in order to determine their skill level, aptitude, and attitude with regard to truck driving. Other roles for the simulator include basic orientation and training in cab familiarization, clutching, shifting, and emergency procedures. The simulator may also be used for evaluation and teaching of more advanced driving skills associated with tractor-trailer operations, including defensive driving.

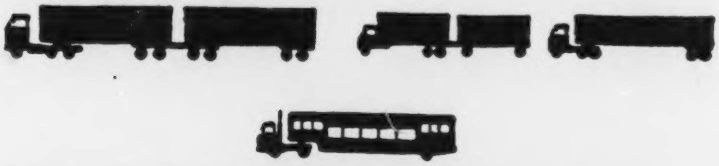
The truck simulator consists of a full-scale mock-up of the driver's position in a "typical" truck cab. The standard unit represents the International Harvester 4070 Tractor equipped with a Cummins NDC 250 engine and an RTO 9513 Roadranger transmission. While the major emphasis is on shifting, it is also possible to perform many of the normal and emergency procedures involved with driving a truck. Through the use of electronic techniques, the engine, transmission and resultant vehicle speed are simulated. This simulation "model" reacts to the driver applicant's inputs in a manner similar to a truck. The user is able to start and stop the "engine", observe instrument readings and realistically simulate moving the vehicle through all gears under varying conditions and situations. To provide realism, engine and transmission noises are generated which realistically relate to engine and vehicle speeds. A special transmission "gear clash" generator provides an aural indication of proper and improper gear shifting. The sound simulations are provided via a 12" speaker, and a volume control is located on the instructor's panel. Operation of the simulator is simple and straightforward: the instructor merely sets up the initial conditions for the student. A separate Instructor's Console is provided for this purpose as well as for instructor monitoring of the student's activity. After initial set-up by the instructor, the driver simply operates the trainer exactly as he would a real vehicle. No further attention by the instructor is required for practice in engine starting and shifting. Malfunctions can, however, be inserted by the instructor from the Instructor's Console.

VEHICLE GROUPS AS ESTABLISHED BY FHWA (SECTION 383.91)

Class **Description:**

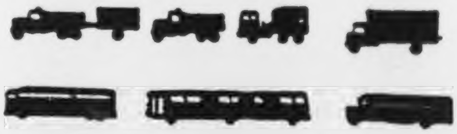
A Any combination of vehicles with a GCWR of 26,001 or more pounds provided the GVWR of the vehicle(s) being towed is in excess of 10,000 pounds. (Holders of a Class A license may, with any appropriate endorsements, operate all vehicles within Classes B and C.)

Examples include but are not limited to:



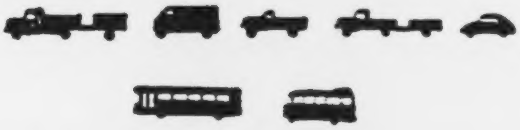
B Any single vehicle with a GVWR of 26,001 or more pounds, or any such vehicle towing a vehicle not in excess of 10,000 pounds GVWR. (Holders of a Class B license may, with any appropriate endorsements, operate all vehicles within Class C.)

Examples include but are not limited to:



C Any single vehicle less than 26,001 pounds GVWR, or any such vehicle towing a vehicle not in excess of 10,000 pounds GVWR. This Class applies to vehicles which are placarded for hazardous materials or designed to transport 16 or more persons, including the operator.

Examples include but are not limited to:



The representative vehicle for the skills test must meet the written description for that group. The silhouettes typify, but do not fully cover, the types of vehicles falling within each group.

ENDORSEMENTS

1. Double/Triple Trailer
2. Passenger (OVER 15 persons including the driver)
3. Tanker
4. Hazardous Materials

SPECIAL RESTRICTION

AIR BRAKES - A 'NO AIR BRAKE' restriction will be placed on drivers that either:

1) fail the part of the written exam on air brakes

OR 2) fail the part of the driving test on air brakes

OR 3) do not take the driving test in a vehicle with air brakes

TRUCK DRIVER SKILL ASSESSMENT AND UPGRADE TRAINING

Sponsored by

BOISE STATE UNIVERSITY

The Federal Vehicle Safety act requires that employers maintain a qualification file on every driver engaged in interstate or intrastate commerce. The Public Utilities Commission has been enforcing this requirement since March 1990.

Starting in July 1990 the Federal and State regulations pertaining to vehicles carrying interstate and intrastate commerce will be required to have a yearly truck inspection. The inspection must be conducted by a qualified person as outlined in the Federal Register, H9 CFR, parts 393 and 396.

Boise State University is providing education in development of the driver qualification files and the procedures for the yearly truck inspections. The program is designed to assist the construction and mining industry in complying with these Federal and State laws. Drivers will be screened on a truck driver simulator for identifying driving habits that need upgrading or modification. These training modules are separate from, and in addition to, the upcoming CDL.

The estimated time for screening each participant on the truck driving simulator, reviewing the truck inspection requirements, and reviewing the safety requirements for the driver qualification files will be approximately 3 1/2 hours.

The program will be offered at the Boise State University Canyon County Center, 2407 Caldwell Blvd., Nampa, Idaho from March 5 through March 23, 1990. On-site service can be arranged for six or more drivers. For more information or to schedule appointments call Don Owen at 334-3216.

CDG\Skill

PROCEDURES AND TRAINING MANUAL

DRAFT

COOPERATIVE DEMONSTRATION GRANT

FEBRUARY, 1989

COMPILED BY:
IDAHO STATE DIVISION OF VOCATIONAL EDUCATION

TABLE OF CONTENTS

PAGE(S)

MISSION STATEMENT 1

ABSTRACT 2

JOB DESCRIPTIONS 3

CONTACT NETWORK/ACTIVITIES 8

MONTHLY REPORTS 9

EVALUATION PLAN 10-14

APPLICATION PROCESS

- SUBMISSION PROCESS 15
- DEFINITION OF TERMS 16
- CHECKLIST 17-20
- INSTRUCTIONS FOR COMPLETING CD-43 21
  - Form CD-43 24
- EDGAR REGULATIONS
  - Retention of Records 26
  - Program Income 28
  - Cost Sharing or Matching 29
  - Coordination with other Activities 34-36
- CARL PERKINS VOCATIONAL EDUCATION ACT 37-39

PROGRAM OPERATIONS

- APPLICATION SUBMISSION PROCEDURES--EXAMPLE 40
- SAMPLE COVER LETTER 41
- CONTRACTOR SURVEY FORM 42-43
- LOCAL ADVISORY COMMITTEES 44

RESOURCES 45-66

STAFF TRAINING

- CURRICULUM DEVELOPMENT 67
  - Outline Model Appendix A
- STANDARDS OF APPRENTICESHIP Appendix B
- SAFETY Appendix C
- PRESENTATION PACKET Appendix D

MISSION STATEMENT

The purpose of this project is to develop, implement, evaluate and disseminate a cooperative construction and mining training program; to provide preapprenticeship training in equipment operation and construction truck driving, with emphasis on equal opportunities for women and minorities; apprenticeship related instruction; and classes in more technical areas for journeymen upgrading. This cooperative program is a joint effort between the Consortium of Area Vocational Education schools (CAVES), Associated General Contractors (AGC), Bureau of apprenticeship and Training (BAT), and five mining companies in northern Idaho.

LD:nw-CDG-117

Abstract
FY1989 Cooperative Demonstration Program CFDA84.199A

Award Number: V199A90141

Recipient: State Division of Vocational Education
650 West State Street
Boise, ID 83720

Contact Persons(s): Dr. Orval Bradley, Project Director
(208) 733-9554
Mr. Richard Winn, Project Coordinator
(208) 334-2659

Project Title: Cooperative Demonstration Program in Construction and Mining

Funds: Federal -- $371,673 Non-Federal -- $123,891 (In-kind Match)

Award Period: January 1, 1989 - June 30, 1990

Target Population: Adults

PURPOSE/OBJECTIVES

The purpose of this project is to develop, implement, evaluate and disseminate a cooperative construction and mining training program to provide preapprenticeship training in equipment operation and construction truck driving, apprenticeship related instruction, and classes in more technical areas for journeyman upgrading. This cooperative program is a joint effort between the Consortium of Area Vocational Education Schools (CAVES), Associated General Contractors (AGC), Bureau of Apprenticeship and Training (BAT) and mining companies in Idaho.

PROCEDURES

This project will:

- provide preapprenticeship programs for females and minorities in equipment operation and/or construction truck driving;
- provide preapprentices with related instruction in the five basic construction trades--equipment operation, construction truck driving, cement masonry, carpentry and laborer;
- provide related instruction for mining apprentices for the mining companies and provide upgrade classes for journeymen construction workers in technical areas.

An ongoing evaluation of the processes and program will be conducted throughout the duration of the project. Curricula developed shall be reviewed and evaluated along with quality of instruction and course content.

OUTCOMES/RESULTS/PRODUCTS

This project will serve an estimated 774 participants, including minorities and females, and provide a statewide program directed toward the five basic construction trades and miners in underground operations.

JOB DESCRIPTION

State Construction Specialist

General

The statewide construction specialist shall be responsible for providing:

- Consultation and training to the coordinators/instructors.
- Develop statewide linkages with private and public organizations.
- Develop and assist in the development of needed curriculum.

Specific

- Provide coordinator training with the following organizations and subject matter:
  a. State EEO requirements
  b. Construction code (OSHA)
  c. Guidelines and operations of the Bureau of Apprenticeship and Training
  d. Flagging and traffic control on construction projects
  e. Personal protective safety
  f. Orientation to contractor organizations
  g. Organize labor involvement
  h. Review the guidelines for this cooperative demonstration project
- Consultation to postsecondary coordinations as to processes to use, agencies to contact, how to establish programs, etc.
- Establish construction curriculum programs to be housed in the state office. Assist coordinators in the development of curriculum, identification of teaching aids available for the construction industry. Materials such as construction safety materials, visual aids, VCR and films available, concepts of "classroom" vs "hands on", vs "OJT", vs related instruction, and when and how to apply these concepts.
- Development of statewide linkages with private and public organizations. Included but not limited to the following:
  a. Associated General Contractors
  b. Associated building contractors
  c. Unions of the five basic trades
  d. Building trades associations
  e. Idaho Department of Transportation
  f. Bureau of apprenticeship and training
  g. Occupational Safety and Health Administration
  h. American Red Cross
  i. Private training resources available
  j. National construction training organizations
  k. Vocational education in other states that provide construction training
- Provide to the coordinators the major construction projects that are being bid in their respective areas.
- Gather, review, organize and submit all data to the State Director of Training for evaluation and future dissemination of literature about the project.
- Provide any service relevant under the supervision of the State Director of Training.

Construction and Mining Specialist/Instructor

All instructional staff hired through this project will meet the Idaho Certification standards for Professional School Personnel (academic and vocational as applicable). Instructional staff will devote 100% of their time to the project.

The conditions of the grant stipulate that the construction and mining specialist/instructor shall report to the CAVES Chairman and/or the Director of Training who reports to the State Administrator of the State Division of Vocational Education. The mining and construction specialist/instructor will be responsible for:

- providing consultation to the coordinator/instructors statewide,
- providing training and technical assistance to the coordinators/instructors statewide,
- developing statewide linkages with public and private organizations in support of the project,
- develop and assist in developing needed curriculum.

The construction and mining specialist/instructor will coordinate and provide training in all aspects of apprenticeship, including OJT supervision, related training, development of standards, establishment of committees and legal implications of apprenticeship programs. The construction and mining specialist/instructor will provide extensive training in safety. This will include but not be limited to eye, ear, foot, and head protection, positions of worker and equipment, construction site safety, respirator training, first-aid and CPR.

JOB DESCRIPTION

Postsecondary Construction Coordinators/Instructors

General

The coordinators shall establish, and in some cases, instruct related training for apprentices, specialized training for journeymen upgrading and become a safety resource person in their institution.

Specific

- Conduct construction needs assessment within the institutions' service delivery area.
- Establish construction advisory committees when appropriate.
- Coordinate programs with area private and public organizations.
- When appropriate, instruct in areas of specialized training.
- Resource person on construction codes from local, state, and federal regulations (OSHA, EDA, IDOT).
- Develop and submit subproposals:
  a. Statement of need
  b. Course outline
  c. Budget narrative
- Coordinate the use of facilities and instructor and recruitment of students for approved construction programs.
- Maintain data for the evaluation and future dissemination of the program.
  a. People and agencies contacted.
  b. All needs assessment (positive and negative)
  c. Number of all students, preapprenticeship, apprenticeship, journeyman upgrading, etc. entered, completed, placed, or reentered industry.
  d. Assisting contractors to meet EED requirements.
  e. All curriculum development.
  f. Data on how local, state and federal agencies were used.
  g. Methods used for liaison and coordination with private industry.
  h. Cost benefit ratio for each program.
  i. Coordinate data requirements from the State Division of Vocational Education with the institution.
- Job site follow up on any apprenticeship programs developed where apprentices are in an On the Job Training (OJT) program.
- Act as a public relations proponent for job entry into the construction industry. They shall publicize the construction programs and the rewards of working in the construction industry.

Construction Coordinator/Instructor

All instructional staff hired through this project will meet the Idaho Certification standards for Professional School Personnel (academic and vocational) as applicable. Instructional staff will devote 100% of their time to the project.

The conditions of the grant stipulate that the construction coordinators/instructors will be under the direct supervision of the postsecondary short-term coordinators, who report to the dean/director of the postsecondary vocational-technical school. The construction coordinator/instructor will be responsible for coordinating with the area private and public organizations to conduct needs assessments within the institution's service delivery area, assist in the establishment of appropriate advisory committees, establish and in some cases instruct related training for apprentices, specialized training for journeyman upgrading and become a safety resource person in their institution.

The construction coordinator/instructor will be trained in construction code, both in the classroom and work site application. Involvement will include the following activities:

- coordinate with the appropriate vocational advisory committees,
- coordinate with the appropriate Joint Apprenticeship committees,
- survey contractors for additional training needs,
- develop curriculum and gather training aids,
- identify subproposal needs,
- coordinate with private and public agencies within the area served,
- assist contractors to meet EEO requirements on federal projects,
- publicize the program and recruit females and minorities for preapprenticeship programs.

The construction coordinator/instructor will be responsible for ongoing evaluations of the programs including curriculum, quality of instruction, and course content. A monthly progress report is required to be submitted to the Director of Training, State Division of Vocational Education.

Mining-Construction Coordinator/Instructor (NIC)

All instructional staff hired through this project will meet the Idaho Certification Standards for Professional School Personnel (academic and vocational) as applicable. Instructional staff will devote 100% of their time to the project.

The conditions of the grant stipulate that the mining-construction coordinator/instructor will be under the direct supervision of the postsecondary short-term coordinator, who reports to the dean/director of the postsecondary vocational-technical school. The mining-construction coordinator/instructor will be responsible for coordinating with the area private and public organizations to conduct needs assessments within the institution's service delivery area; assist in the establishment of appropriate advisory committees; establish and in some cases instruct related training for apprentices, specialized training for journeymen upgrading, and become a safety resource person in their institution.

The mining-construction coordinator/instructor will be trained in construction code, both in the classroom and work site application. Involvement will include the following activities:

- coordinate with the appropriate advisory committees,
- coordinate with the appropriate Joint Apprenticeship committees,
- survey contractors for additional training needs,
- conduct program evaluations,
- develop curriculum and gather training aids,
- identify subproposal needs,
- coordinate with private and public agencies within the area served,
- assist contractors to meet EEO requirements on federal grants,
- publicize the program and recruit female and minorities for preapprenticeship programs.

The mining-construction coordinator/instructor will be responsible for ongoing evaluation of the programs including curriculum, quality of instruction and course content. A monthly progress report is required to be submitted to the Director of Training, State Division of Vocational Education.

COORDINATOR'S CONTACT NETWORK/ACTIVITIES

1. Liaison and coordination with private industry.

2. Enhance coordination between private and public agencies and vocational education.

3. Establish knowledgeable vocational education people in each postsecondary school to continue coordination with construction and mining industries after completion of project.

4. Identify and train females and minorities for EEO compliance.

   Publicize program and contact following agencies for recruitment of women/minorities:

   (a) displaced homemaker centers
   (b) Idaho Migrant Council
   (c) tribal governments
   (d) community based organizations
   (e) vocational rehabilitation agencies
   (f) agencies serving handicapped

   Contact network to include:

   (a) Contractors
   (b) Contractor associations
   (c) Trade organizations (unions)
   (d) Advisory committees
   (e) County highway districts
   (f) Transportation departments
   (g) Department of Labor and Industrial Services
   (h) Bureau of Apprenticeship and Training
   (i) Displaced Homemaker Centers
   (j) Dislocated worker programs
   (k) Idaho Migrant Council
   (l) Tribal Governments
   (m) Vocational Rehabilitation
   (n) Other

5. Assist in establishment of advisory committees.

6. Coordinate with area private and public organizations.

7. Conduct needs assessment within each delivery area.

8. Develop statewide linkages.

9. Conduct contractor survey.

LD:nw-CDG-120

COORDINATOR'S MONTHLY REPORTS

Monthly reports will be sent to State Coordinator or Director of Training to reflect and evaluate:

a. Direct service to participants:

   (1) Number of preapprentices served.
   (2) Number of apprentices served.
   (3) Number of journeymen served.
   (4) Number of females and minorities served.

b. Services rendered:

   (1) Number and type of curricula developed.
   (2) Staff training sessions attended.
   (3) Number of females and minorities referred for placement.

c. Liaison with private and public sector:

   (1) Number of contacts made:
      (a) Contractors
      (b) Contractor associations
      (c) Trade organizations (unions)
      (d) Advisory committees
      (e) County highway districts
      (f) Transportation departments
      (g) Department of Labor and Industrial Services
      (h) Bureau of Apprenticeship and Training
      (i) Displaced Homemaker Centers
      (j) Dislocated worker programs
      (k) Idaho Migrant Council
      (l) Tribal Governments
      (m) Vocational Rehabilitation
      (n) Other

The monthly reports will also state in narrative form any problems, activities, or other accomplishments during the month. Reports are due the 15th of each following month; ie reports for February are due March 15.

LD:nw:CDG:119

EVALUATION

The internal evaluation includes activities designed to measure the quality of instruction, course content and program efficiency. The evaluation of instruction and course content will be conducted with a student survey designed to gather information on the quality of instruction, course content, instructor effectiveness, quality of facilities, etc. student learning will be measured through the assessment process and pre- and post-testing. Additional programs evaluative information will be solicited from supervisors and employers for programs conducted in the workplace.

Monthly reports will be obtained to review and evaluate:

1. The activities of the Construction/Mining Coordinator
   a. number of business/industry contacts
   b. development of programs/curriculum
   c. progress of programs

2. The efficiency of the identification and referral networks
   a. the number of business/industry contacts
   b. the development and use of advisory committee(s)
   c. the types and number of activities identified
      - contractors
      - contractor associations
      - trade organizations (unions)
      - advisory committees
      - county highway districts
      - transportation departments
      - Department of Labor and Industrial Services
      - Bureau of Apprenticeship and Training
      - Displaced Homemaker Centers
      - dislocated worker programs
      - Idaho Migrant Council
      - Tribal Governments
      - Vocational Rehabilitation
      - other

3. The progress of programs iin operation
   a. the number of individuals enrolled in the program
   b. the number of contact hours for the month
   c. the number of individuals completing programs
   d. the types of programs being operated

The monthly progress reports will also state any problems or accomplishments during the month and additional participant and program information as required.

On-site program reviews will be conducted by the statewide construction specialist and/or the project director and grants management coordinator.

The external evaluation will be conducted by the Northwest Regional Education Laboratory (NWREL). Formal details of the formative evaluation will be available after the Washington conference which is scheduled for February, 1989.

STUDENT PROGRAM EVALUATION

Program ____

Date ______________________

Interviewer ____

1. Was the program too long or too short? (Please explain)

2. Was there adequate classroom and/or hands-on training?

3. Any suggestions for improving the class?

4. Are there any questions you didn't get to ask or didn't get answers to?

5. Do you feel you learned enough to go to work in this field?

Please rate the following on a scale from 1 - 5, with 5 being excellent and 1 being poor:

6. Quality of facilities (1 - 5)________

Quality of instructional materials (1 - 5)________

Quality of instructor (1 - 5)________

Additional comments:

86

PREAPPRENTICESHIP EVALUATION

1. Now that you have been exposed to the construction industry is there a specific trade you are interested in entering?

   Yes ______ No ______ If yes, which one?

2. When you near your 18th birth date would you be interested in receiving an apprenticeship application form?

   Yes ______ No ______

3. What is the most appealing aspect about working in construction?

4. Did the preapprenticeship program help you decide to explore other occupations before you make a decision?

ADMINISTRATIVE PROGRAM EVALUATION

Equipment and Tools

1. Is all the needed equipment available? Yes _____ No _____
2. Is the available equipment of a realistic quality for training?
   Yes _____ No _____
3. Recommendations (if any) ____
   ____
   ____

Personal Protective Equipment

1. Is the necessary protective equipment available? Yes _____ No _____
2. Was the protective equipment being properly used? Yes _____ No _____
3. Do the trainees seem safety conscious? Yes _____ No _____
4. Recommendations (if any) ____
   ____
   ____

Materials

1. Are all the needed supplies available (block, concrete, lumber, etc.)?
   Yes _____ No _____
2. Are the quality of supplies sufficient? Yes _____ No _____
3. Recommendations (if any) ____
   ____
   ____

Curriculum

1. Are there topics that need to be added to the curriculum?
   Yes _____ No _____

Curriculum (continued)

2. Are there topics that need to be deleted from the curriculum?

Yes ______ No ______ If yes, which one(s) ____________________________

____

____

3. Should the sequence of instruction be modified? Yes ______ No ______

4. Does the length of the program appear to be too short?

Yes ______ No ______, or too long? Yes ______ No ______

5. Recommendations (if any) ____

____

____

Audiovisual Information

1. Are there other materials that should be introduced?

Yes _____ No _____ If yes, what are the sources of material?

____

____

____

2. Recommendations (if any) ____

____

____

3. Does it appear that the trainees have obtained sufficient skills for entering the industry? Yes _____ No _____

4. Recommendations (if any) ____

____

____

Program ____

Evaluator ____

Date ______________________________ CD-105

APPLICATION PROCESS

APPLICATION SUBMISSION PROCESS

Overview

This is a cooperative demonstrative grant; therefore, the evaluation of the project focuses upon how much and how well coordination is conducted with the construction industry and other appropriate organizations and agencies.

Literature developed from this proposal will be disseminated throughout the United States. Curriculum developed, apprenticeship standards, industry coordination, reporting procedures etc. will be available to all state vocational educational agencies.

The expenditure of funds must have a clear audit trail and relate to this proposal. The funds must be spent on new projects not existing programs.

The grant requires that at least $123,891 of in-kind match be generated during the operation of this proposal. This means that 33% of all the coordinators salaries, program expenditures and evaluative cost must have in-kind match equal to 33% of the total. Any federally derived dollars cannot be used as match. Therefore, it is of the utmost importance that the identification and documentation of in-kind match be considered when submitting proposals.

The programs must be conducted in compliance with EDGAR. Each school should have a copy of EDGAR. This grant must comply with federal regulations in addition to the state and institutional regulations.

DEFINITION OF TERMS

Pre-entry Training--Training that occurs prior to being employed in the industry.

Construction and Apprenticeship Orientation--Explores jobs in the construction industry in the fine crafts. This program is used as a decision making process and entails:

- requirements to enter the industry,
- how to enter the industry
- safety
- equipment and tool nomenclature.

Preapprenticeship--Provides a familiarization with a particular occupation. Enrollees are provided information and knowledge of the content of a specific trade. The intent of this program is to place enrollees into a regular apprenticeship program.

EEO Compliance--Provided to females and minorities to assist contractors to meet their EEO compliance. Sufficient skills are taught so a participant will have some productive skills when entering industry.

Mining--480 hours of preemployment training to ensure participants obtain many of the skills needed in the mining industry.

Apprenticeship--Programs developed for new entries into the construction industry. The program consists of both OJT and related instruction of the craft. The OJT portion is provided by the contractor at a preestablished apprenticeship rate of pay. The related instruction is in addition to OJT and is conducted after normal working hours.

Journeyworker Upgrading--This program provides the journeyworker new training or upgrade training needed to maintain certifications or to meet qualifications for additional job classifications.

Foreman or Supervisory Training--These are advanced programs of a more technical nature and are directed toward decision making or managing construction projects.

Postentry Training--Training that is provided after a person has entered the industry.

NOTE: We request use of these guidelines when submitting proposals. The preentry programs could also be considered preapprenticeship; however, for proposal submission use these definitions and the checklist for classifications.

APPLICATION SUBMISSION PROCESS CHECKLIST

PRE-ENTRY TRAINING

____ Construction and apprenticeship orientation

____ Preapprenticeship

____ EEO Compliance

____ Mining

POST-ENTRY TRAINING

____ Apprenticeship

____ Journeyworker upgrading

____ Foreman and supervisory

Statement of Need (program justification)--Describe the reasons why this program needs to be conducted. Submit any survey results, job market data or economic conditions that would validate the approval of this proposal.

____ Survey results

____ Job market data

____ Economic conditions

____ Other

Letters of Support--Submit letters of support from contractors, labor organizations or agencies that request or support the need for this proposal.

____ Contractors

____ Labor

____ Organizations

____ Agencies

____ Advisory committee recommendations

____ Standards with apprenticeship proposals

____ Other

Course Outline--The course outline will consist of:

____ Course objectives statement

____ Instructor objectives statements

____ Curriculum outline--sequence of what and when the major components will be taught

____ List of all equipment to be used

____ List of all printed information and source(s)

____ List of audiovisual material and source(s)

Budget Narrative

The budget narrative will itemize all cost showing formulas of how each cost was computed. Additional sentences or paragraphs may be needed to fully describe the use of the funds. Include in the narrative the in-kind contributions showing how the value of the contributions were determined.

Budget

____ Salary

____ Fringe Benefits

____ Instructional Supplies

____ Travel

____ Facility Lease/Rent

____ Equipment Lease

____ Other

In-Kind Contributions

____ Equipment

____ Space

____ Materials and Supplies

____ Student Fees (non federally derived)

____ Volunteer Service

____ Other

____ Percentage of in-kind contribution

Program Coordination

During the application process there must be a description of the involvement with contractors, organizations and agencies in the development of this proposal. The description should be in written form. Coordination shall include one or more of the following methods of coordination:

____ Planning the project with organizations and individuals who have similar objectives or concerns.

____ Sharing information, facilities, staff, services, or other resources.

____ Engaging in joint activities such as instruction, needs assessment, evaluation, monitoring, and technical assistance and staff training.

____ Using the grant funds so as not to duplicate or counteract the effects of funds made available under other programs.

____ Using the grant funds to increase the impact of funds made available under other programs.

____ Other

The following checklist is used to identify those organizations and agencies that vocational education works with to coordinate grant subproposals:

____ Contractors

____ Contractor Groups

____ Contractor Organizations

____ Unions

____ Trade Organizations

____ Advisory Committee

____ Displaced Homemaker Centers

____ Dislocated Worker Programs

____ Tribal Governments

____ Other

Governmental Agencies

____ Bureau of Apprenticeship and Training

____ City Maintenance Departments

____ County or District Transportation Departments

____ OSHA

____ Department of Labor and Industrial Services

____ Idaho Migrant Council

____ Vocational Rehabilitation

____ MSHA

____ U.S. Forest Service

____ Bureau of Land Management

____ Bureau of Mines

____ Postsecondary Learning Centers

____ Department of Employment

The total program evaluation will be based on the following items:

____ Coordination with industry, organizations and agencies

____ Development of curriculums

____ Program evaluation by participants

____ Development of apprenticeship standards

____ Number of participants served

____ Other

CDG-121-sub.pro

COOPERATIVE DEMONSTRATION PROJECT
INSTRUCTIONS FOR COMPLETING
CAVES Form No. CD-43

This form is to be used for all programs funded with Cooperative Demonstration funds including: Preapprenticeship Training, Related Instruction or apprentices, and Journeyman Upgrade, and must include:

- Statement of Needs
- Letters of support/request for services from the industry
- Course Outline
- Budget Narrative (including contributions)
- Description of how the program will be coordinated with the construction industry and involved agencies and organizations

Instructions for completing the form:

1. Name of member school and person responsible for the program.

2. Name of organization and the contact person for which the training is being conducted (if applicable).

3. Program title.

4. Proposed starting and ending dates.

5. Day(s) of the week and time(s) of the day class will be held.

6. Total hours of instruction.

7. Name of instructor. Teacher certification (Vo. Ed. No. 7) must be completed and submitted with this form if the teacher is not certified. (Teachers need only be certifiable, not certified.)

8. Initial number of students to start the program. Estimated total number of students to be served during the program.

9. Show the total Cooperative Demonstration funds requested and the total amount of matching (other) funds to be provided in each category. Administrative funds are not allowable with Cooperative Demonstration funds, but may be used to meet the matching requirement.

   Equipment may be leased but not purchased with Cooperative Demonstration funds.

   A budget narrative detailing Cooperative Demonstration funds and the source of matching funds must be attached.

MATCHING FUNDS for Cooperative Demonstration programs may include cash or in-kind non-federal contributions. Matching funds shall reflect only those costs or portion of costs directly applicable to those students enrolled in the Cooperative Demonstration project.

Cash Contributions are any non-federal cash used for the operation of a Cooperative Demonstration program.

In-Kind Contributions are non-cash non-federal contributions provided by the member school or third parties. Resources for in-kind contributions are:

Space. Space may be provided to the Cooperative Demonstration programs at no cost or at a reduced rate. In the former case, the entire cost of the space (at fair rental rate) may be claimed as in-kind; in the latter case, the difference between the normal cost and the reduced rate may be claimed.

Utilities and Maintenance. Public utilities, janitorial services and other costs that are not normally absorbed by the provider of the space in the fair rental rate may be claimed as in-kind.

Equipment and Supplies. In-kind contributions may be claimed for the value of equipment or supplies donated (or loaned) for Cooperative Demonstration activities, including equipment, machinery, training supplies, etc.

The cost of equipment purchased for a specific Cooperative Demonstration program with matching funds may be used with the following conditions:

- The total cost may be used for a one-time match; or
- The amount of depreciation may be used over a period of years if the total cost of the equipment was not used at the time of purchase; and
- If students other than those enrolled in the Cooperative Demonstration program utilize the equipment, the prorated portion shall not be used for match.

Volunteer Services. Unpaid services provided to a recipient by individuals shall be valued at rates consistent with those ordinarily paid for similar work in the recipients organization. If the recipient does not have employees performing similar work, the rates shall be consistent with those ordinarily paid by other employers for similar work in the same labor market. In either case, a reasonable amount for fringe benefits may be included in the valuation.

Employees of Other Organizations. When an employer other than a recipient or cost-type contractor furnishes free of charge the services of an employee in the employee's normal line of work, the services shall be valued at the employee's regular rate of pay *exclusive* of the employer's fringe benefits and overhead costs. If the services are in a different line of work, the paragraph pertaining to volunteer services shall apply.

Release Time for Employees Attending Cooperative Demonstration Programs. When an employer allows an employee to attend Cooperative Demonstration programs during regular work hours and continues to pay the employee's salary, the matching funds shall be calculated at the employee's regular rate of pay exclusive of the employer's fringe benefits and overhead costs. Match may only be calculated for those hours that the employee is attending class.

CAVES Form CD-4

COOPERATIVE DEMONSTRATION PROJECT
CONSORTIUM OF AREA VOCATIONAL EDUCATION SCHOOLS
and
IDAHO STATE DIVISION OF VOCATIONAL EDUCATION
650 West State Street, Boise, Idaho 83720

Application for Approval of Cooperative Demonstration Training

1. Member School ______________________ City ____________, Idaho

   Contact Person ______________________ Phone ____________

2. Business/Organization ______________________ City ____________, Idaho

   Contact Person ______________________ Phone ____________

3. Program Title ______________________________________

4. Proposed starting date ____________ Ending no later than ____________

5. Class meets on M, T, W, Th, F, S, from ____________ to ____________
   Clock Time / Clock Time

6. Hours of Instruction ____________

7. Name of Instructor ______________________ (Submit Vo-Ed Form No. 7)

8. Initial Enrollment ____________ Estimated Total Enrollment ____________

9. Program Costs

	CD FUNDS	MATCHING/ OTHER FUNDS
a. Administrative Costs	N/A	
b. Instructional Salary		
c. Fringe Benefits		
d. Instructional Supplies		
e. Instructional Travel		
f. Facility Lease/Rent		
g. Equipment Lease		
h. Other		
i. GRAND TOTAL		

understand that the Consortium of Area Vocational Education Schools (CAVES) and the State Division of Vocational Education have no obligation to fund this proposal until an approved copy has been returned. I certify that funds requested in this proposal will be used to supplement and not supplant funds otherwise available for the services proposed. I further certify that I am authorized to enter the organization specified above to the terms of this agreement and any other documents affixed or referred to in this agreement.

Signed ______________________________ Date ______________
CAVES Representative

Signed ______________________________ Date ______________
Authorized School Official

Signed ______________________________ Date ______________
Cooperating Agency/Organization

Signed ______________________________ Date ______________
Project Director

State Division of Vocational Education to complete the following:

One copy approved by the Consortium of Area Vocational Education Schools and the State Division of Vocational Education will constitute an agreement for financial or other assistance as noted below.

Remarks ____

____

____

Signed ______________________________ Date ______________
Adminstrator, Vocational Education

Project # ______________

Section 74.21 Length of Retention Period

(a) except as provided in paragraphs (b) and (c) of this section, records shall be retained for 3-years from the starting date specified in section 74.22

(b) if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration date of the 3-year period, the records shall be retained until the completion of all issues which arise from it, or until the end of the regular 3-year period, whichever is later.

(c) in order to avoid duplicate recordkeeping, awarding parties may make special arrangements with recipients to retain any records which are continuously needed for joint use. The awarding party will request transfer of records to its custody when it determines that the records possess long-term retention value. When the records are transferred to or maintained by the awarding party, the 3-year retention requirement is not applicable to the recipient.

Section 75.734 Record Retention Period

Unless a longer period is required under 34 CFR Part 74, a grantee shall retain records for five years after the completion of the activity for which it uses grant funds.

Section 74.22 Starting Date of Retention Period

(a) General. (1) Where ED grant support is continued or renewed at annual or other intervals, the retention period for the records of each funding period starts on the day the grantee submits to ED its single or last expenditure report for that period. However, if ED grant support is continued or renewed quarterly, the retention period starts on the day the grantee submits to ED its expenditure report for the last quarter of the Federal fiscal year. In all other cases, the retention period starts on the day the report would have ben due. "Expenditure Report" is defined in section 74.3.

(2) Exceptions to this paragraph are continued in paragraphs (b) through (d) of this section.

(b) Equipment records. The retention period for the equipment records required by section 74.140(a) starts from the date of the equipment's disposition (Section 74.139) or replacement (Section 74.138) or transfer at the discretion of the awarding party.

(c) Records for income transactions after grant or subgrant support.

(1) In some cases an ED requirement concerning the disposition of program incomes, as defined in Subpart F of this part, will be satisfied by applying the income to costs incurred after expiration or termination of grant or subgrant support for the activity giving rise to income. In such a case, the retention period for the records pertaining to the costs starts from the end of the recipient's fiscal year for which the costs are incurred.

(2) In some cases, there may be an ED requirement concerning the disposition of copyright royalties or other program income which is earned after expiration or termination of grant of subgrant support. Where there is such a requirement, the retention period for the records pertaining to the earning of the income starts from the end of the recipients fiscal year in which the income is earned.

(d) Indirect cost rate proposals, cost allocation plans. etc.-

(1) Applicability. This paragraph applies to the following types of documents,and their supporting records: (i) indirect rate cost rate computations or proposals; (ii) cost allocation plans under appendix C to this part; and (iii) any similar accounting computations of the rate at which a particular group of costs is chargeable (such as computer usage chargeback rates or composite fringe benefit rates.)

(2) If submitted for negotiation. If the proposal, plan, or other computation is required to be submitted to the Federal Government (or to the grantee) to form the basis for negotiation of the rate, then the 3-year retention period for its supporting records starts from the date of submission.

(3) If not submitted for negotiation. If the proposal, plan, or other computation is not required to be submitted to the Federal Government (or to the grantee) for negotiation purposes, then the 3-year retention period for the proposal, plan, or other computation and its supporting records starts from the end of the fiscal year (or other accounting period) covered by the proposal, plan, or other computation.

Section 74.23 Substitution of Microfilm.

Copies made by microfilming, photocopying, or similar methods may be substituted for the original records.

Section 74.41 Meaning of Program Income.

(a) Except as explained in paragraphs (b) and (c) of this section, program income means gross income earned by a recipient from activities part or all of the cost of which is either borne as a direct cost by a grant or counted as a direct cost towards meeting a cost sharing or matching requirement of a grant. It includes, but is not limited to such income in the form of fees for services performed during the grant or subgrant period, proceeds from sale of tangible personal or real property, usage or rental fees, and patent or copyright royalties. If income meets this definition, it shall be considered program income regardless of the method used to calculate the amount paid to the recipient- whether, for example, by a cost-reimbursement method of payment or fixed price arrangement. Nor will the fact that the income is earned by the recipient from a Federal procurement contract or from a procurement contract under a Federal grant awarded to another party affect the income's classification as a program income.

(b) For research grants that are subject to an institutional cost-sharing agreement, income shall be considered program income only if it is earned from an activity part or all of the cost of which is borne as a direct cost by the Federal grant funds. An institutional cost sharing agreement is one entered into between ED and a grantee covering all of ED's research projects grants to the grantee in the aggregate.

(c) The following shall not be considered program income:

(1) Revenues raised by a government recipient under its governing powers, such as taxes, special assessments, levies, and fines. (However, the receipt and expenditure of such revenues shall be recorded as part of grant or subgrant project transactions when such revenues are specifically earmarked for the project in accordance with the terms of the grant or subgrant.)

(2) Tuition and related fees received by an institution of higher education for a regularly offered course taught by an employee performing under a grant or subgrant.

Subpart G - Cost Sharing or Matching

Section 74.51 Definitions

For purposes of this subpart:

"Cost sharing or matching" means the value of third-party in-kind contributions and that portion of the costs of a grant-supported project or program not borne by the Federal government.

"Equipment" has the same meaning given to that term in Section 74.132, except that instead of 'acquisition cost,' the words market value at the time of donation" shall be substituted.

"Supplies" means all tangible personal property other than "equipment" as defined in this section.

"Third-party in-kind contributions" means property or services which benefit a grant-supported project or program and which are contributed by non-federal third parties without charge to the grantee, the subgrantee, or a cost-type contractor under the grant or subgrant.

Section 74.52 Basic Rule: Costs and Contributions Acceptable.

With the qualifications and exceptions listed in Section 74.53, a cost-sharing or matching requirement may be satisfied by either or both of the following:

(a) Allowable costs incurred by the grantee, the subgrantee, or a cost-type contractor under the grant or subgrant. This includes allowable costs borne by non-Federal grants or by other cash donations form non-Federal third parties.

(b) The value of third-party in-kind contributions applicable to the period to which the cost-sharing or matching requirement applies.

Section 74.53 Qualifications and Exceptions.

(a) Costs Borne by Other Federal Grants.

  (1) Except a provided by Federal statute, a cost-sharing or matching requirement may not be met by costs borne by another federal grant. This prohibition does not apply to costs borne by general program income earned from a contract awarded under another Federal grant.

  (2) For purposes of this part, general program revenue sharing funds under 31 U.S.C. 1221 are not considered a Federal grant. Therefore, in the absence of any provision of Federal statute to the contrary, allowable costs borne by these funds may count towards satisfying a cost-sharing or matching requirement.

(b) Costs or contributions counted towards other federal cost-sharing requirements. Neither costs nor the values of third-party in-kind contributions may count towards satisfying a cost-sharing or matching requirement of an ED grant if they have been or will be counted towards satisfying a cost-sharing or matching requirement of another Federal grant, a Federal procurement contract, or any other award of Federal funds.

(c) Costs financed by general program income. Costs financed by general program income, as defined in Section 74.42 shall not count towards satisfying a cost-sharing or matching requirement of the ED grant supporting the activity giving rise to the income unless the terms of the grant expressly permit the income to be used for cost sharing or matching. (This is the alternative use of general program income described in Section 74.42(d).)

(d) Records, costs and third-party in-kind contributions counting towards satisfying a cost-sharing or matching requirement must be verifiable from the records of recipients or cost-type contractors. These records must show how the value placed on third-party in-kind contributions was arrived at. To the extent feasible, volunteer services shall be supported by the same methods that the organization uses to support the allocability of its regular personnel costs.

(e) Special standards for third-party in-kind contributions.

(1) Third-party in-kind contributions shall count towards satisfying a cost-sharing or matching requirement only where, if the party receiving the contributions were to pay for them, the payments would be allowable costs.

(2) A third-party in-kind contribution shall not count as direct cost-sharing or matching where, if the party receiving the contribution were to pay for it, the payment would be an indirect cost. Cost-sharing or matching credit for such contributions shall be given only if the recipient or contractor has established along with its regular cost rate, a special rate for allocating to individual projects or programs the value of the contributions.

(3) The values placed on third-party in-kind contributions for cost-sharing or matching purposes shall conform to the rules in the succeeding sections of this subpart. If a third-party in-kind contribution is of a type not treated in those sections, the value placed upon it shall be fair and reasonable.

Section 74.54 Valuation of Donated Services.

(a) Volunteer services. Unpaid services provided to a recipient by individuals shall be valued at rates consistent with those ordinarily paid for similar work in the recipients organization. If the recipient does not have employees performing similar work, the rates shall be consistent with those ordinarily paid by other employers for similar work in the same labor market. In either case, a reasonable amount for fringe benefits may be included in the valuation.

(b) Employees of other organizations. When an employer other than a recipient or cost-type contractor furnishes free of charge the services of an employee in the employee's normal line of work, the services shall be valued at the employee's regular rate of pay exclusive of the employer's fringe benefits and overhead costs. If the services are in a different line of work, paragraph(a) of this section shall apply.

Section 74.55 Valuation of donated supplies and loaned equipment and space.

(a) If a third party donates supplies, the contribution shall be valued at the market value of the supplies at the time for donation.

(b) If a third party donates the use of equipment or space in a building but retains title, the contribution shall be valued at the fair rental rate of the equipment or space.

Definitions:

"Equipment" means tangible personal property having a useful life of more than one year and an acquisition cost of $300 or more per unit except that organizations subject to the Cost Accounting Standards Board (CASB) regulations may use the CASB standard of $500 or more per unit and useful life of two years. An organization may use its own definition of equipment: Provided, That such definition would at least include all tangible personal property as defined herein.

"Personal property" means property of any kind except real property. It may be tangible-having physical existence, or intangible, such as patents, inventions, and copyrights.

"Real property" means land, including land improvements, structures and appurtenances thereto, but excluding movable machinery and equipment.

"Replacement equipment" means property acquired to take the place of other equipment. To qualify as replacement equipment, it must serve the same function as the equipment replaced and must be of the same nature or character, although not necessarily the same model, grade, or quality.

COST ALLOWABILITY

1. Factors affecting allowability of costs. To be allowable under a grant program, costs must meet the following general criteria:

   a. Be necessary and reasonable for proper and efficient administration of the grant program, be allocable thereto under these principles and, except as specifically provided herein, not be general expense required to carry out the overall responsibilities of state or local governments.

   b. Be authorized or not prohibited under state or local laws or regulations.

   c. Conform to any limitations or exclusions set forth in these principles, Federal laws, or other governing limitations as to types or amounts of cost items.

   d. Be consistent with policies, regulations, and procedures that apply uniformly to both federally assisted and other activities of the unit of government of which the grantee is a part.

   e. Be accorded consistent treatment through application of generally accepted accounting principles to the circumstances.

Section 75.562 Indirect cost rates for educational training projects.

(a) The Secretary may approve an indirect cost rate for an educational training project at the lesser of-

   (1) The actual indirect cost rate of the grantee; or

   (2) Eight percent of the total direct costs of the project.

(b) This section does not apply to-

   (1) A State (as defined in 34 CFR 74.3); or

   (2) A local government (as defined in 34 CFR 74.3).

Section 75.580 Coordination with other activities.

(a) A grantee shall, to the extent feasible, coordinate its project with other activities that are in the same geographic area served by the project and that serve similar purposes and target groups.

(b) A grantee whose project includes activities to improve the basic skills of children, youth, or adults, shall, to the extent possible, coordinate its project with other basic skills activities that are in the same geographic area served by the project.

(c) For the purposes of this section, "basic skills" means reading, mathematics, and effective communication, both written and oral.

(d) The grantee shall continue its coordination during the project period.

Section 75.581 Methods of Coordination.

Depending on the objectives and requirements of its project, a grantee shall use one or more of the following methods of coordination:

(a) Planning the project with organizations and individuals who have similar objectives or concerns.

(b) Sharing information, facilities, staff, services, or other resources.

(c) Engaging in joint activities such as instruction, needs assessment, evaluation, monitoring, and technical assistance and staff training.

(d) Using the grant funds so as not to duplicate or counteract the effects of funds made available under other programs.

(e) Using the grant funds to increase the impact of funds made available under other programs.

110

Section 75.590 Evaluation by the grantee.

A grantee shall evaluate at least annually-

(a) The grantee's progress in achieving the objectives in its approved application;

(b) The effectiveness of the project in meeting the purposes of the program; and

(c) The effect of the project on persons served by the project, including:

  (1) Any persons who are members of groups that have been traditionally underrepresented, such as--

    (i) Members of racial or ethnic minority groups;
    (ii) Women;
    (iii) Handicapped persons; and
    (iv) The elderly; and

  (2) If the program statute requires that private school students be provided an opportunity to participate, the students who are enrolled in private schools.

111

Section 74.61(h) Audit

(1) General.

(i) This paragraph applies to each recipient that is not subject to the audit requirements in Appendix G to this part.

(ii) Public hospitals and public colleges and universities are subject to this paragraph if excluded under paragraph 4 of Appendix G of this part.

(iii) A financial and compliance audit shall be made in accordance with generally accepted auditing standards, including the standards of the U.S. General Accounting Office's publication "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions." The auditors engaged by a recipient shall meet the criteria for qualifications and independence in that publication.

(2) Purpose and Scope. The purpose of these audits shall be to determine the effectiveness of the financial management systems and internal procedures established by the recipient to meet the terms of its grant and subgrants. The recipients auditors need not examine every grant or subgrant awarded to the recipient. Rather, audits generally should be made on an organization-wide basis to test the fiscal integrity of financial transactions and compliance with the terms of awards. These tests would include an appropriate sampling of Federal grants and subgrants.

(3) Frequency. These audits shall be conducted on a continuing basis or at scheduled intervals, usually once a year, but at least every two years. The frequency shall depend on the nature, size and complexity of the recipients grant- or subgrant-supported activities.

(4) Relation to Federal audit. These audits may affect the frequency and scope of the Federal audit. However, nothing in this section is intended to limit the right of the Federal Government to conduct an audit of grant- or subgrant-supported activity.

(5) Audit resolution. The recipient shall follow a systematic method to assure timely and appropriate resolution of audit findings and recommendations.

(6) Copies of audit reports. A copy of each audit report and a description of its resolution, shall be furnished to ED.

112

CARL D. PERKINS VOCATIONAL EDUCATION ACT

Part C - Adult Training, Retraining, and Employment Development

Findings and Purpose

Sec. 321.(a) The Congress finds that--

(1) technological change, international competition, and the demographics of the Nation's workforce have resulted in increases in the numbers of adult workers who are unemployed, who have been dislocated, or who require training, retraining, and upgrading of skills,

(2) many women entering and reentering the paid labor market are disproportionately employed in low-wage occupations and require additional training,

(3) many adults cannot gain access to or benefit fully from vocational education due to limited English language proficiency, and

(4) these needs can be met by vocational education programs that are responsive to the needs of individuals and the demands of the labor market.

(b) It is the purpose of this part (1) to provide financial assistance to the States to enable them to expand and improve vocational education programs designed to meet urgent needs for training, retraining, and employment development of adults who have completed or left high school and are preparing to enter or have entered the labor market, in order to equip adults with the competencies and skills required for productive employment, and (2)to ensure that such programs are relevant to the labor market needs and accessible to all segments of the population, including women, minorities, the handicapped, individuals with limited English language proficiency, workers fifty-five and older, and the economically disadvantaged.

Authorization of Grants and Uses of Funds

Sec. 322

(a) From the portion of the allotment of each State under Section 101 available for this part, the Secretary shall make grants to the States for programs, services, and activities authorized by this part.

(b) (1) Grants to States under this part may be used, in accordance with State plans, for--

(a) vocational education programs, services, activities, and employment development authorized by title II which are designed to meet the needs of--

(i) individuals who have graduated from or left high school and who need additional vocational education for entry into the labor force;

113

(ii) unemployed adults who require training to obtain employment or increase their employability;

(iii) employed individuals who require retraining to retain their jobs, or who need training to upgrade their skills to qualify for higher paid of more dependable employment;

(iv) displaced homemakers and single heads of households who are entering or reentering the labor force;

(v) employers who require assistance in training individuals for new employment opportunities or in retraining employees in new skills required by changes in technology, products or processes; and

(vi) workers fifty-five and older;

(B) short-term programs job retraining designed to upgrade or update skills in accordance with changed work requirements;

(C) education and training programs designed cooperatively with employers, such as--

(i) institutional and worksite programs, including apprenticeship training programs (or combinations of such programs) especially tailored to the needs of an industry or group of industries for skilled workers, technicians, managers, or to assist their existing work force to adjust to changes in technology or work requirements; and

(ii) quick-start, customized training for workers in new and expanding industries, or for workers for placement in jobs that are difficult to fill because of a shortage of workers with the requisite skills.

(D) building more effective linkages between vocational education programs and private sector employers (through a variety of programs including programs where secondary school students are employed on a part-time basis as registered apprentices with transition to full-time apprentices upon graduation), and between eligible recipients of assistance under this Act and economic development agencies and other public and private agencies providing job training and employment services, in order to more effectively reach out to and serve individuals described in subparagraph (A;

(E) cooperative education programs with public and private sector employers and economic development agencies, including seminars in institutional or worksite setting, designed to improve management and increase productivity;

(F) entrepreneurship training programs which assist individuals in the establishment, management, and operation of small business enterprises;;

114

(G) recruitment, job search assistance, counseling, remedial services, and information and outreach programs designed to encourage and assist males and females to take advantage of vocational education programs and services, with particular attention to reaching women, older workers, individuals with limited English language proficiency, the handicapped, and the disadvantaged;

(H) curriculum development, acquisition of instructional equipment and materials, personnel training, pilot projects, and related and additional services and activities required to effectively carry out the purposes of this part;

(I) the costs of serving adults in other vocational education programs, including paying the costs of instruction of the costs of keeping school facilities open longer; and

(J) related instruction for apprentices in apprenticeship training programs.

PROGRAM OPERATIONS

APPLICATION SUBMISSION PROCESS
EXAMPLE

Multi-level Programs

Some programs may in fact serve several categories of participants.

Example--For a person to direct traffic (flagging) on a construction project he/she must possess a valid flaggers card. This card is needed by a laborer trainee prior to entering the OJT portion of the standards under the Bureau of Apprenticeship and Training.

Flagging training may also be given to a female and/or minority which would assist contractors in meeting their EEO compliance. The program can also be considered as journeyworker upgrading as certification must be updated every three years.

When submitting a flagging proposal, please list it as journeyworker upgrading; but note on the application if this is their first flagging card. This should allow more accuracy and clarity in the reporting process.

STATE OF IDAHO
DIVISION OF VOCATIONAL EDUCATION
650 West State Street #324 Boise, Idaho 83720

SAMPLE COVER LETTER

TRAINING NEWS

The Idaho Division of Vocational Education is in the process of emphasizing training programs for the construction industry.

As you are aware Idaho experienced a construction slump several years ago and many of the skilled craftsman have left our area.

The six postsecondary vocational educational schools located in Boise, Coeur d'Alene, Idaho Falls, Lewiston, Pocatello and Twin Falls have initiated some programs for the construction industry. Along with these vocational-technical schools the State Division of Vocational Education is placing a high priority for the development of other programs earmarked just for the construction industry.

We are in the process of determining what training programs are needed in the five basic trades of equipment operator, construction truck driver, cement mason, carpenter and laborer.

We are asking you to take a few minutes of your time to complete the enclosed check list. Your response will assist us in determining which programs to focus our attention on.

Thank you for your prompt consideration.

Sincerely,

CDG:100nw

Celebrate IDAHO
1890 · CENTENNIAL · 1990
AN EQUAL OPPORTUNITY EMPLOYER

CONTRACTORS TRAINING SURVEY

Please check needed areas:

☐ *Preapprenticeship*

A program to expose high school students and others to opportunities in the construction industry. The length of the program has yet to be determined.

☐ *Apprenticeship*

Contractors can explore the feasibility of establishing apprenticeship programs for their companies. Assistance can be provided in developing standards acceptable for apprenticeship.

☐ *Flagging & Basic Traffic Control*

Four-hour program which meets the State's requirements for a certified flagger. Cards are issued after successful completion of the program.

☐ *Air Powered Tools*

Basic program for new entry-level people. It includes servicing and use of compressors, practice with jackhammer pavement breaker and chipping gun.

☐ *First Aid and CPR*

Red Cross approved program that is eight hours in length.

☐ *Equipment Operation*

Eight-week program for females and minorities to assist contractors to meet their EEO requirements.

☐ *Construction Truck Driving*

Four-week program for females and minorities to assist contractors to meet their EEO requirements.

☐ *Concrete Seminar*

Two-day program for contractors and their foremen.

☐ *Traffic Control*

Program for foremen and supervisors on the uniform traffic control systems.

☐ *Blueprint Reading*

Basic 40-hour blueprint reading program.

☐ *Laser*

16-hour program for the use of lasers in both building construction and pipe laying.

☐ *OSHA Construction Rules & Regulations*

16-hour overview of construction safety based on OSHA regulations.

☐ *Supervisorial Training Program*

Basic program of 40 hours and is designed for foremen and supervisors.

☐ *Other*

DO:nw
CDG:100

PROGRAM OPERATION

Establishment and Role of Advisory Committees

Vocational advisory committees shall be formed for each region from persons representing the construction industry, contractor associations, the Bureau of Apprenticeship and Training, and/or other knowledgeable construction persons.

Joint Apprenticeship committees shall be established under the guidelines of the Bureau of Apprenticeship and Training.

The committees shall assist in the needs identification and curriculum review. The mining advisory committee shall be comprised of equal representation of management and labor.

For additional information on advisory committees see: Voc-Ed #170 Revised 1988, A Handbook for Vocational Advisory Committees.

CDG-122

RESOURCES

FILM INDEX

1-31-89

WESTERN STATES
EQUIPMENT COMPANY

General Offices ● P.O. Box 38 ● Boise, ID 83707
ADDRESS CORRECTION REQUESTED
RETURN POSTAGE GUARANTEED

SERIES A

NO.	
1	910 Product
2	Fair Warning
3	Saving Money at the Finish
4	Making the Most of Downtime
5	Series "G" Motor Gradeers
6	Which is Which
7	Operating Tips - Elevating Scrapers
8	D3
9	Better by Design
10	Heart of the Matter
11	8mm Demonstration Film
12	Key to Your Needs
13	There's Got to be a Better Way
14	Just for Openers
15	Good Deal More - CAT Plus
16	The Steel Shoe Beadless Tire
17	Handling Rail Cars with CAT Wheel Loaders
18	Snow Removal
19	225 with La Bounty Grapple
20	Doing the World's Work
21	The 931's Got it.
22	Just for Openers - Two Parts
23	Balderson Snow Removal Attachments
24	225 La Bounty
25	Maricopa County Reports
26	Hardwick, Mass. Reports
27	Topeka, KS. Reports
28	Different by Design
29	D9L the New Standard od Values

SERIES B

1 988B - The Competitor
2 The Winners - The Losers
3 Loading Logic
4 Milestones
5 Color of Danger
6 Good Deal More - Meeting Ver.
7 Operating Tips - Off-Hwy. Trucks
8 Undercarriage by CAT
9 Tell Tale Atoms
10 Percentages
11 The Shape of Things to Come
12 Versatality with a Boom
13 The Winners - The Losers
14 What to do, and When to do it
15 Operator's Guide - Track-Type Tractors
16 Dirt the Quiet Thief
17 The Roll of Drums
18 Paper Clips and Buggy Whips
19 Operator's Guide - Rubber-Tired Tractors
20 The Color of Danger
21 Operator's Guide - 769 Truck
22 Blues in Three Parts
23 Operator's Guide - Track-Type Loader
24 Operator's Guide - Motor Graders
25 Operator's Guide - Wheel Loaders
26 The Roll of Drums
27 Double Duty
28 The Edge in Mining
29 Born in the West
30 The XT Connection

SERIES B CON'T

31 Operator's Guide for Hyd. Excavators
32 Soil Water Conservation Demonstration
33 Down is Up
34 Paper Clips & Buggy Whips
35 Operator's Tips - Motor Graders
36 Making the Most With Scrapers
37 The Only Part that Matters
38 An X Factor
39 Operating Tips - Wheel Tractors
40 Operating Tips - Wheel Loaders
41 Question of Value
42 225 Proof
43 An X Factor
44 Question of Value
45 Ques for Excellence
46 Big Wheels in the Woods
47 Everything to Lose
48 Everything to Lose
49 The Gamblers
50 Snow Problem
51 Western Logging Then and Now
52 Where Will it All End
53 Ripping
54 The Big Track
55 Why Handle it Twice
56 Breakout - The 992C
57 D10 - The New Shape of Value
58 Versatility With a Boom - Part 2
59 Operating In The Black
60 Improving Your Worth

SERIES B CON'T.

61 Operating Tips - Push-Pull Scrapers
62 D10- The Shape of Value
63 Operating Tips - Track-Type Tractors
64 Operating Tips - Track Loaders
65 14 Ways to Work with Wood
66 Shake Hands with Danger
67 " " " "
68 " " " "
69 Wingwalking
70 245 Front Shovels at Work
71 Color of Danger
72 Ground Engaging Tools
73 More Ways to Work With Wood
74 Changes in Timber Harvesting
75 Uncommon Versatility
76 The Choice is Yours
77 Winning Moves in Maintenance
78 Reliability: Design & Manufacture
79 SIGNALS "READ THEM AND WEEP"
80 A Proven Value

SERIES C

1 The Struggle for Power
2 There Will be a Slight Delay
3 Struggle for Power
4 One Turn of the Earth
5 Lands of Promise - Fields of Hope - Land development for ag.
6 Minerals - Idaho's Hidden Resources
7 Challenge of Safety
8 Choices
9 Everything Rides on the Roads
10 Big Track
11 Responding to a Changing World
12 Multinational Business
13 Springfield Gun
14 800 Miles of Winter
15 Everything Rides on the Road
16
17 Women Must Weep
18 Everything Rides on the Roads
19 Something in the Air
20 Phoenix '76
21 Year of Disaster
22 Roll of Drums
23 Renewal of our Rangelands
24 Trouble with Trash
25 Multiple Choices
26 Multiple Choices
27 Multiple Choices
28 Multiple Choices
29 Monuments
30 Where in the World
31 800 Miles of Winter
32 There's Plenty of Gold
33 CLEAN WATER - WHAT'S IN IT FOR YOU - SEWAGE
34 Timber on The Move

Table of Contents— AGC Services

AGC Training and Education

1 Construction: Apprenticeship Opportunities Unlimited For Young Men And Women P-1
2 Construction: Opportunities Unlimited (Open Shop) P-1
3 Collegiate Construction Education Directory P-1
4 A University Interviewing and Recruiting Guide For Construction Contractors P-1
The Importance of Cooperative Education, Internship, and Work Study Programs for the Construction Contractor P-1
5 Educational Goals and Recommended Construction Curricula for the Construction Industry P-2
7 AGC Student Chapter Officers' Guide P-2
8 AGC Student Chapter Promotional Flyer P-2
10 Construction P-2
11 Construction Career Promotion Poster (24x36 in.) P-2
12 Construction Career Promotion Poster (18x24 in.) P-2
14 The AGC Successor Work Experience Exchange Program P-2
19 AGC Financial Management Program Videocassettes P-2
19.1 Financial Management Program Promotion Flyers P-3
25 Supervisory Training Program Wall Chart P-3
26 Supervisory Training Program Instructor's Handbook P-3
27 STP Catalog P-3
28 STP Story P-3
801 Construction...The Competitive Industry ¾-inch UMATIC videocassette P-3
802 Construction...The Competitive Industry ½-inch VHS videocassette P-3
830 Construction...Building Your Future 16mm film P-4
830.1 Construction...Building Your Future Promotional flyer P-4
831 Construction...Building Your Future ¾-inch UMATIC videocassette P-4
832 Construction...Building Your Future ½-inch VHS videocassette P-4
835 Career Promotion Slide Presentation P-4
836 Careers in Construction ½-inch VHS videocassette P-4
837 Careers in Construction ½-inch Beta videocassette P-4
838 Careers in Construction ¾-inch UMATIC videocassette P-4
1035 Student Chapter Decals 6" X 5" P-4
1036 Student Chapter Decals 3" X 2½" P-4

AGC Supervisory Training Program (STP)

25 Supervisory Training Program Wall Chart P-6
26 Supervisory Training Program Instructor's Handbook P-6
27 STP Catalog P-7
28 STP Story P-7
Supervisory Training Program Order Form P-8

AGC Craft Curricula

30 Bricklaying Basic Core Instructor Package P-12
31 Bricklaying Basic Core Student Edition P-12
32 Principles of Bricklaying Instructor Package P-13
33 Principles of Bricklaying Student Edition P-13
34 Advanced Bricklaying Techniques Instructor Package P-13
35 Advanced Bricklaying Techniques Student Package P-13
36.1 Bricklaying Competency Profile P-13
36.2 Bricklaying Transparencies P-13
40 Fundamentals of Carpentry Instructor Package P-13
41 Fundamentals of Carpentry Student Edition P-13
42 Residential Carpentry. Instructor Package P-14
43 Residential Carpentry. Student Edition P-14
44 Commercial Carpentry Instructor Package P-14
45 Commercial Carpentry Student Edition P-14
46.1 Carpentry Competency Profiles P-14
50 Fundamentals of Concrete and Cement Masonry Instructor Package P-14
51 Fundamentals of Concrete and Cement Masonry Student Edition P-14
52 Concrete and Cement Masonry Skills Instructor Package P-15
53 Concrete and Cement Masonry Skills Student Edition P-15
54.1 Concrete and Cement Masonry Competency Profile P-15
60 Construction Craftsman Instructor Package P-15
61 Construction Craftsman Student Edition P-15
62.1 Construction Craftsman Competency Profile P-15
62.2 Construction Craftsman Transparencies P-15
70 Heavy Equipment Operator Basic Core Instructor Package P-16
71 Heavy Equipment Operator Basic Core Student Edition P-16
72.1 Heavy Equipment Operator Competency Profile P-16
72.2 Heavy Equipment Operator Transparencies P-16
73 Heavy Equipment Operator: General Equipment Instructor Package P-16
74 Heavy Equipment Operator: General Equipment Student Edition P-16
75.1 Heavy Equipment Operator: General Equipment Competency Profile P-16
76 Heavy Equipment Mechanic Instructor Package P-16
77.1 Heavy Equipment Mechanic Competency Profiles P-16
77.2 Heavy Equipment Mechanic Transparencies P-17
77.3 Orientation Student Edition P-17
77.4 Engines Student Edition P-17
77.5 Engine Accessories Student Edition P-17
77.6 Hydraulics Student Edition P-17
77.7 Auxiliary Systems Student Edition P-17
77.8 Suspension Student Edition P-17
77.9 Cutting & Welding Student Edition P-17
80 Industrial Mechanical Maintenance Instructor Package P-17
81 Industrial Mechanical Maintenance Student Edition P-17
82.2 Industrial Mechanical Maintenance Transparencies P-17
90 Millwright Instructor Package P-18
91 Millwright Student Edition P-18
92.1 Millwright Competency Profile P-18
92.2 Millwright Transparencies P-18
99 Open Shop Training: Unilateral Trainee Program Guide P-18

AGC Safety, Health, and Accident Prevention

100 Manual of Accident Prevention in Construction P-19
101 Supervisor's Report of Accident Investigation P-19
102 Blasting Log P-19
103 MSHA Guide P-19
104 Correspondence Course—Safety Training for Construction Supervisors P-19
104.1 Course Outline—Safety Training Course for Construction Supervisors P-19
105 Guide for Voluntary Compliance with OSHA P-20
106 Hazardous Substances Guide for Construction P-20
107 Emergency Telephone Number Signs P-20
108 Emergency Telephone Number Stickers P-20
131-150 Safety Training Series P-20
160 Guide to Drug-Free Jobsites P-21
161 Drug-Free Workplace ½-inch VHS videocassette P-21
162 Drug-Free Workplace ½-inch Beta videocassette P-21
163 Drug-Free Workplace ¾-inch VHS videocassette P-21
1080 "We Love A Safe Jobsite" Emblem P-21
1090 "I Love A Drug-Free Jobsite" Emblem P-21

Table of Contents—AGC Services

International Construction

190 Conditions of Contract (International)—FIDIC P-23
191 International Contractors' Directory P-23
192 The Contribution of Architectural, Engineering and Construction Exports to the U.S. Economy P-23

Construction Documents (Engineering Construction)

200 Standard General Conditions of the Construction Contract (for engineering construction) P-25
201 Contract Documents for Construction of Federally Assisted Water and Sewer Projects P-25
202 Standard Form of Agreement Between Owner and Contractor on the Basis of a Stipulated Price P-25
203 Standard Form of Agreement Between Owner and Contractor on the Basis of Cost-Plus P-25
204 Change Order P-25
205 Certificate of Substantial Completion P-25
206 Application for Payment P-25
207 Work Directive Change P-26
208 Guide to the Preparation of Instruction to Bidders P-26
209 Guide to the Preparation of Supplementary Conditions P-26
210 Suggested Bid Form and Commentary for Use P-26
211 Engineer's Letter to Owner Requesting Instructions Re Bonds and Insurance During Construction P-26
212 Owners' Instructions to Engineer Re Bonds and Insurance During Construction P-26
213 Notice of Award P-26
214 Notice to Proceed P-26
221 Standard Questionnaires and Financial Statement for Bidders (For Engineering Construction) P-26
230 Wastewater Treatment Standard Proposal Form P-26
235 Outline for Reports of Site Investigations—Heavy & Utilities Construction P-27
1101 Manual of Contract Documents P-28

Construction Documents (Building Projects)

300 Standard Form of Agreement Between Owner and Contractor P-29
301 General Conditions of the Contract For Construction P-29
305 Abbreviated Form of Agreement Between Owner and Contractor P-29
310 Standard Form of Agreement Between Owner and Contractor—Cost Plus Fee P-29
317 Abbreviated Form of Agreement Between Owner and Contractor P-29
320 Contractor's Qualification Statement P-29
321 Instructions to Bidders, 1987 Edition P-29
325 Recommended Guide for Competitive Bidding Procedures and Contract Awards For Building Construction P-29
327 Guide to Supplemental Conditions P-29
330 Change Order P-30
335 Application and Certificate for Payment and Continuation Sheet P-30
340 Certificate of Substantial Completion P-30
400 Preliminary Design-Build Agreement P-30
405 Design-Build Guidelines P-30
410 Standard Form of Design-Build Agreement and General Conditions Between Owner and Contractor (guaranteed maximum price) P-30
415 Standard Form of Design Build Agreement and General Conditions Between Owner and Contractor (lump sum) P-30
420 Standard Form of Agreement Between Contractor and Architect P-30
430 Conditions Between Contractor and Subcontractor for Design-Build P-30
440 Change Order/Contractor Fee Adjustment P-30
450 Standard Design-Build Subcontract Agreement With Subcontractor Not Providing Design P-30
450.1 Standard Design-Build Subcontract Agreement With Subcontractor Providing Design P-31
500 Standard Form of Agreement Between Owner and Construction Manager P-31
501 Amendment to Owner-Construction Manager Contract P-31
510 Standard Form of Agreement Between Owner and Construction Manager (Owner Awards all Trade Contracts) P-31
520 General Conditions for Trade Contractors Under Construction Management Agreements P-31
525 Change Order/Construction Manager Fee Adjustment P-31
540 Construction Management Guidelines P-31
545 Construction Management Control Process P-31
550 Owner Guidelines for Selection of a Construction Manager P-31
560 Construction Management Delivery Systems for Hospital Facilities P-31
570 Budget Estimating and Control During the Design Phase P-32
580 Construction Project Planning and Scheduling Guidelines P-32
600 Standard Subcontract Agreement For Building Construction P-32
603 Short Form Subcontract P-32
605 Standard Subbid Proposal P-32
610 Subcontractor's Application for Payment P-32
614 Invitation to Bid Form for Subcontractors P-32
615 A Suggested Guide and Checklist for Subcontracts P-32
623 Construction Industry Survival Kit Slide Show-Cassette/Videotape P-33
624 Construction Industry Survival Kit P-33
625 AGC Certificate of Substantial Completion P-33
630 First Budget Estimate Guideline P-33
645 Standard Form of Negotiated Agreement Between Owner and Contractor P-33
650 An Owner's Guide to Building Construction Contracting Methods P-33
655 Guide to Owner's Responsibility for Construction Projects P-33

Employee-Related Documents

705 Davis-Bacon Manual—Labor Standards for Federal and Federally-Assisted Construction P-35
707 Labor Practices Audit P-35
709 A Practical Guide to Open Shop Construction P-35
710 Open Shop Personnel Management and Operations Handbook P-35
712 AGC Model Construction Workers Registry System P-35
715 Labor Relations Manual For Open Shop Contractors P-35
721 How the 1980 Multiemployer Amendments Affect the Construction Industry (ERISA Manual) P-36
722 Multiemployer Pension Plan Conversion — Defined Benefit to Defined Contribution P-36
723 Inventory of Construction Industry Multiemployer Pension Plans P-36
723.1 Executive Summary and Analysis of AGC's Pension Plan Inventory P-36
730 Federal Laws Relating to Employment of Labor in Construction P-36
732 Resolving Jurisdictional Disputes in the Construction Industry P-36
734 AGC Guide to Compliance with the Immigration Reform & Control Act of 1986 P-37
734.1 The Immigration Reform Legislation of 1986 ½-inch VHS videocassette P-37
734.2 The Immigration Reform Legislation of 1986 ½-inch Beta videocassette P-37
734.3 The Immigration Reform Legislation of 1986 ¾-inch VHS videocassette P-37
735 AGC Equal Opportunity Manual for Construction P-37

Table of Contents—AGC Services

735 AGC Equal Opportunity Manual for Construction P-37
736 Meeting the Challenge of a Free Market in Construction: A Labor-Management Partnership for Productivity and Market Development P-37
737 Multiemployer Bargaining in the Construction Industry P-37

Equipment Ownership & Rental and Crime Prevention

900 Contractors' Equipment Cost Guide P-39
905 AGC Equipment Record (Bond Paper) P-39
906 AGC Equipment Record (Card Stock) P-39
907 AGC Equipment Rental Agreement P-39
910 Superintendent's Guide to Theft and Vandalism Prevention P-39
915 Serial Number Location and Identification Guide P-39
851 Crime Prevention: A Management Tool ¾-inch videocassette P-39
852 Crime Prevention: A Management Tool ½-inch videocassette P-39

AGC Emblems (AGC Members Only)

1000-1028 AGC Emblems P-40
1030-1031 National Associate Member Emblems P-40
1035-1036 Student Chapter Emblems P-40
1050 AGC Lapel Pin P-41
1055 AGC Tie Tack P-41
1060 National Associate Lapel Pin P-41
1065 AGC Emblem Reproduction Proofs P-41
1066 National Associate Emblem Reproduction Proofs P-41
1067-1068 Chapter Associate Emblems P-41
1069-1070 Chapter Affiliate Emblems P-41
1071 Chapter Associate Emblem Reproduction Proofs P-41
1072 Chapter Affiliate Emblem Reproduction Proofs P-41
1075 Five Reasons Why the AGC Emblem Can Help Your Business P-41
1080 "We Love A Safe Jobsite" Emblem P-41
1090 "I Love A Drug-Free Jobsite" Emblem P-41

General Publications

1101 Manual of Contract Documents P-43
1102 Manual of Contract Documents Update Service P-44
1103 Manual of Bidding, Estimating and Accounting Documents P-44
1107 The Use of CPM in Construction P-44
1110 Masterformat (Replaces the Uniform Construction Index) P-44
1111 AGC Cost Classification Index-Broadscope Edition P-44
1112 Guidelines for Obtaining Industrial/Process Construction P-44
1115 Summary of State Regulations and Taxes Affecting General Contractors P-45
1125 Private Work: Managing The Risks P-45
1128 The Basic Bond Book P-45
1130 Insurance and Bond Check List P-45
1131 Guide to Construction Insurance P-45
1132 Construction Risk Management Manual P-45
1142 Maximize Public Funds With the Contract Method of Construction P-45
1143 Energy Conservation Guidelines P-46
1145 Public Relations Handbook for Contractors P-46
1146 Construction Marketing and Strategic Planning P-46
1150 Guidelines for the Builder/Developer P-46
1194 AGC Standards of Ethical Conduct. (poster) P-46
1195 AGC Standards of Ethical Conduct. (booklet) P-46
1202 Construction Issues and Positions P-46
1204 AGC Programs, Products, Services Implementing the Business Roundtable's Construction Industry Cost Effectiveness Studies P-46
1206 Experienced Owners Use The Single Contract Method of Construction for Cost-Effective Construction P-47
1208 Action In The Eighties—An Update on AGC's Cost-Effective Programs, Products & Services P-47

AGC National Newsletter

1196 AGC National Newsletter Subscription P-47

CONSTRUCTOR

1197 CONSTRUCTOR Magazine P-48
1148 Directory of AGC General Contractor and National Associate Members P-48
1203 CONSTRUCTOR's Inventory of Computer Software for General Contractors P-48
CONSTRUCTOR Order Blank P-49

Infrastructure

2000 America's Infrastructure: A Plan to Rebuild. P-50
2002-2005 Infrastructure. (film-videocassette) P-50
2006-2009 Water: America's Most Vital Resource. (film-videocassette P-50
2010-2013 Buildings: Our Vertical Infrastructure. (film-videocassette) P-51
2015-2017 Infrastructure Newsreel. P-51
2021 America in Ruins—An Update: A Public Works Financing Strategy P-51
2022 Infrastructure—The Aftermath and Realization: A Call for Action P-51
2023 Closing the Gap P-51

Economics

3000 Construction/Investment Spending: An Engine of Economic Growth—Underinvestment and Economic Growth in the U.S. P-52
3001 America's Infrastructure: Effects of Construction Spending—Study of a $10 Billion Annual Infrastructure Investment P-52

Special Preference Programs

4000 Cost and Impact of Minority Enterprise Goals and Quotas in the Construction Industry P-53
4001 The Cost and Impact of Small Business Set-Aside Programs in the Construction Industry P-53
4003 Stop Legislated Discrimination—The Case Against Section 105(f) of the 1982 Surface Transportation Assistance Act P-53

AGC Seminar Cassettes P-54-64

Order Forms

AGC Seminar Cassette Order Forms P-63-64
AGC General Publication Order Form P-65
AGC Supervisory Training Programs (STP) Order Form P-8
AGC Craft Curricula Order Form P-67

TABLE OF CONTENTS

Page

I. INTRODUCTION 1

A. Identification of Materials in This Guide 1

B. How to Use This Guide 3

II. GENERAL APPRENTICESHIP 6

III. CONSTRUCTION AND CONSTRUCTION RELATED TRADES 18

IV. CULINARY AND CULINARY RELATED TRADES 26

V. ELECTRICAL AND ELECTRICAL RELATED TRADES 38

VI. GRAPHICS AND GRAPHICS RELATED TRADES 51

VII. HEAVY EQUIPMENT OPERATIONS TRADES 62

VIII. MECHANICS AND MECHANIC RELATED TRADES 65

IX. MEDICAL AND MEDICAL RELATED TRADES 78

X. METALS AND METALS RELATED TRADES 83

XI. PLUMBING, PIPEFITTING, STEAMFITTING AND RELATED TRADES 97

XII. MISCELLANEOUS TRADES 101

XIII. PRIVATE AND SEMI-PRIVATE VENDORS 105

XIV. SUPPORTIVE INFORMATION 127

A. Related Training Delivery Systems 128

B. Basic History of Apprenticeship 134

C. Federal Apprenticeship Regulations 138

D. Job Corps Programs and their Relationship to Apprenticeship.. 139

XV. APPENDICES

A. EDRS Order Information 141

DRAFT

IHI IDAHO HIGHWAY INFORMATION

IDAHO TRANSPORTATION DEPARTMENT

A BIMONTHLY CONSTRUCTION AND REST AREA REPORT

Cecil D. Andrus, Governor Jan.-Feb. 1989

A "rotary" mops up the aftermath of a winter storm on Goose Creek Summit north of McCall on Idaho 55.

Annual Report shows progress

The Transportation Department's Fiscal Year 1988 Annual Report is now available.

The report charts the department's progress during the last fiscal year in its highway, motor vehicle, aeronautics, railroad and public transit programs. A summary of the fiscal year's financial data is also included.

Copies are available from the Transportation Department Public Information Office, P.O. Box 7129, Boise, 83707 or by telephon-

ITD crews prepared for winter roads

Although icy roads will challenge motorists' skills and reaction speed this winter, maintaining the state's transportation network will be a matter of routine for the Idaho Transportation Department.

The ITD is well-prepared for meeting the demands of a demanding season. It takes a lot of equipment and manpower to meet the problems imposed by combinations of snow, wind, ice, rain, fog and other changing weather conditions. A lot of fortitude and stamina is also needed to be called out of bed at any hour to tackle a blizzard or other emergency situation.

To accomplish this big task the department has more than $41 million in maintenance equipment. This includes 407 trucks with snowplows and sanders, 27 rotary plows, four trucks equipped with V plow attachments and 63 motor graders.

This equipment is used by the snow and ice fighters for plowing, salting and sanding operations which keep the roads clear for the many school buses, trucks and cars that use the state's highway system.

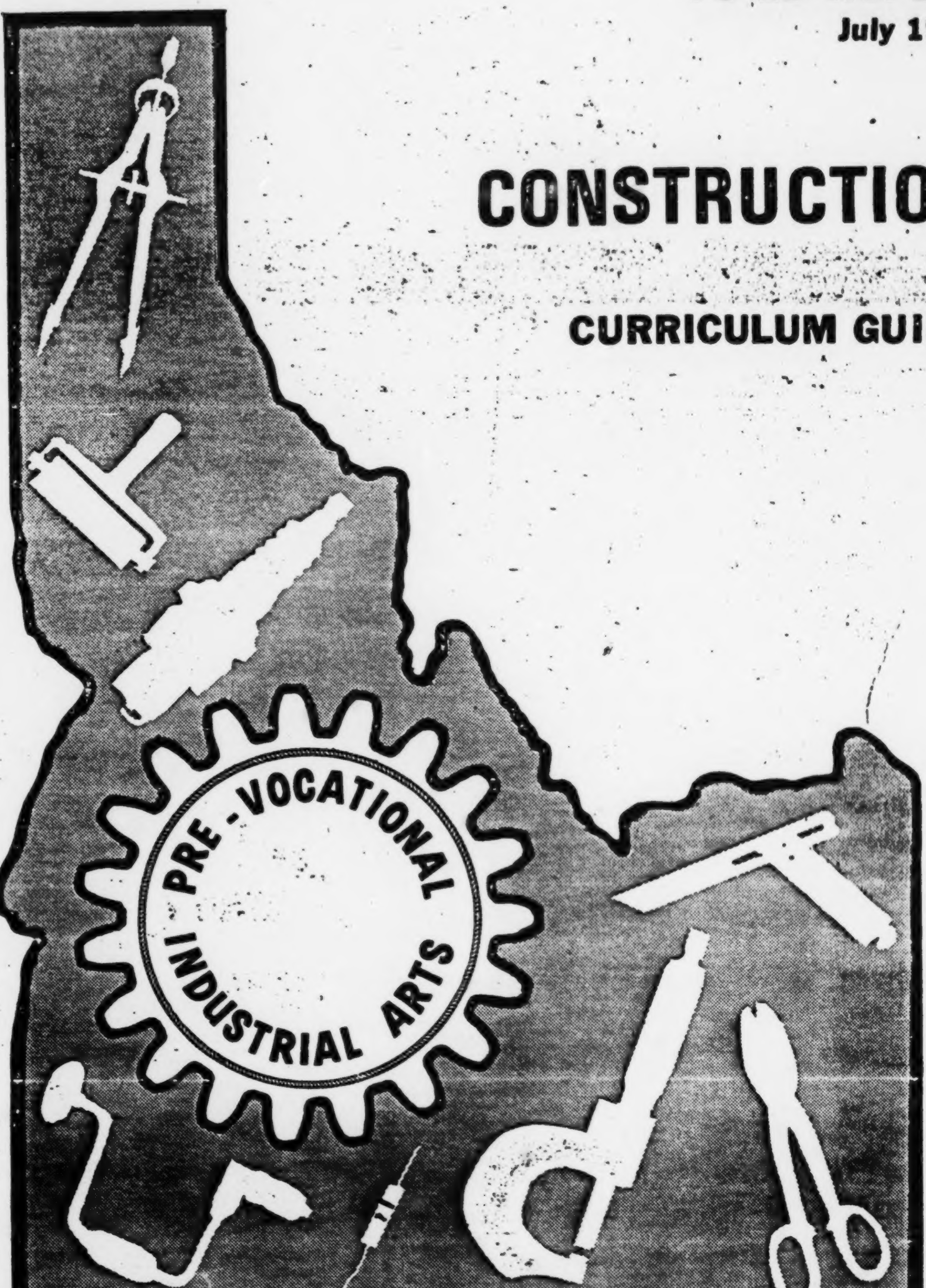
Last year, approximately $5.7 million was spent for snow and ice removal, sanding and other winter control requirements. The lower cost reflects a relatively mild winter. Under normal conditions, the average cost of winter maintenance is approximately $6.1 million.

This price tag is paid by state highway user dollars. No federal-aid funds are used for maintaining any of our state highway systems. Total yearly maintenance expenditures on Idaho highways varies between $35 million and $36 million per year, depending a

VO ED NO. 145
July 1975

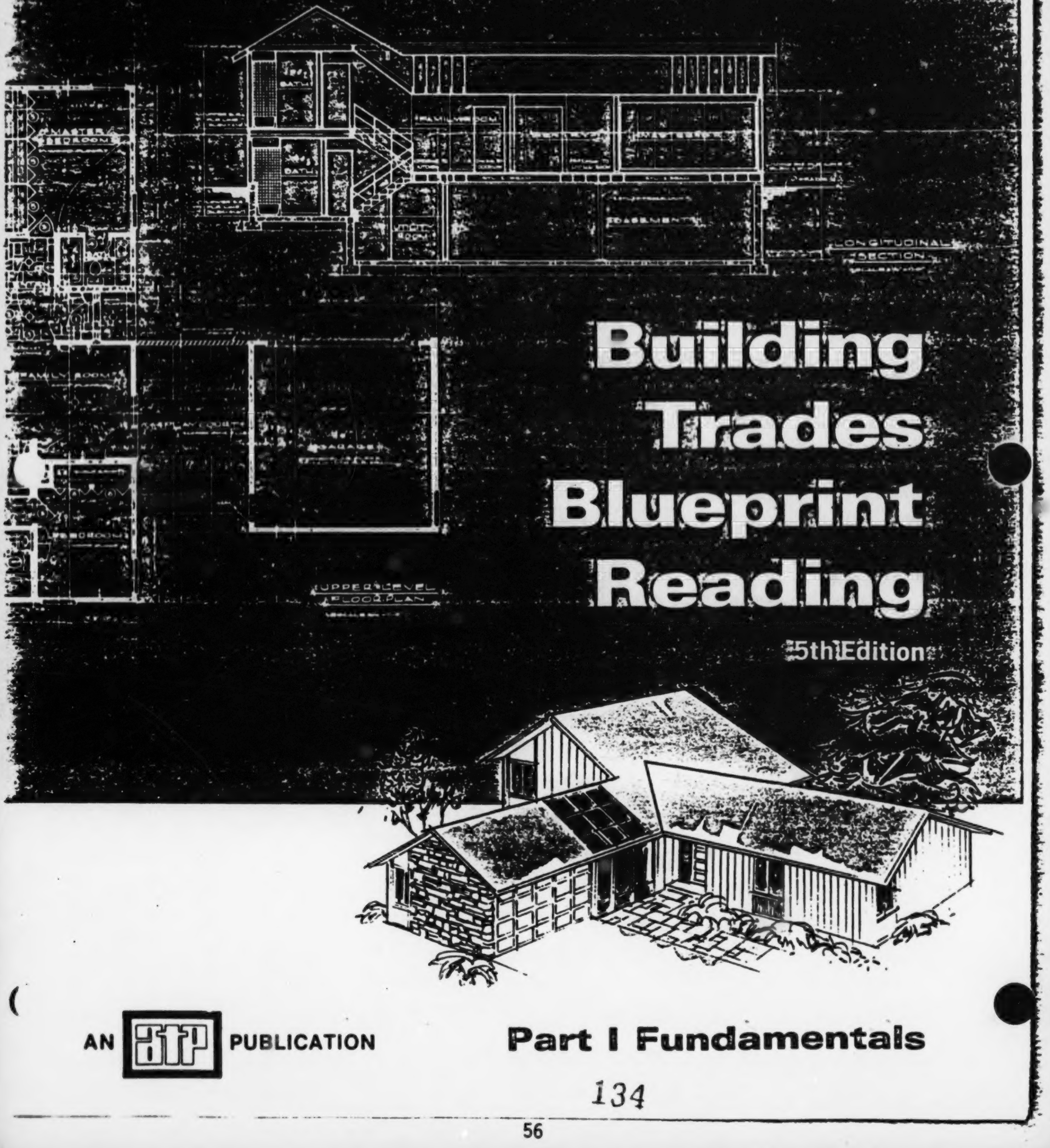
CONSTRUCTION

CURRICULUM GUIDE


PRE-VOCATIONAL
INDUSTRIAL ARTS

IDAHO STATE BOARD FOR VOCATIONAL EDUCATION

Elmer W. Sundberg


BATH
BATH
MASTER BEDROOM
FAMILY ROOM
BASEMENT
UTILITY ROOM
LONGITUDINAL SECTION
FAMILY ROOM
GARAGE
BEDROOM
UPPER LEVEL FLOOR PLAN

Building Trades Blueprint Reading

5th Edition

AN atp PUBLICATION

Part I Fundamentals

134

National Safety Council

MATERIALS PRICE LIST

EFFECTIVE **January 31, 1986**

National Safety Council

A Nongovernmental, Nonprofit Public Service Organization

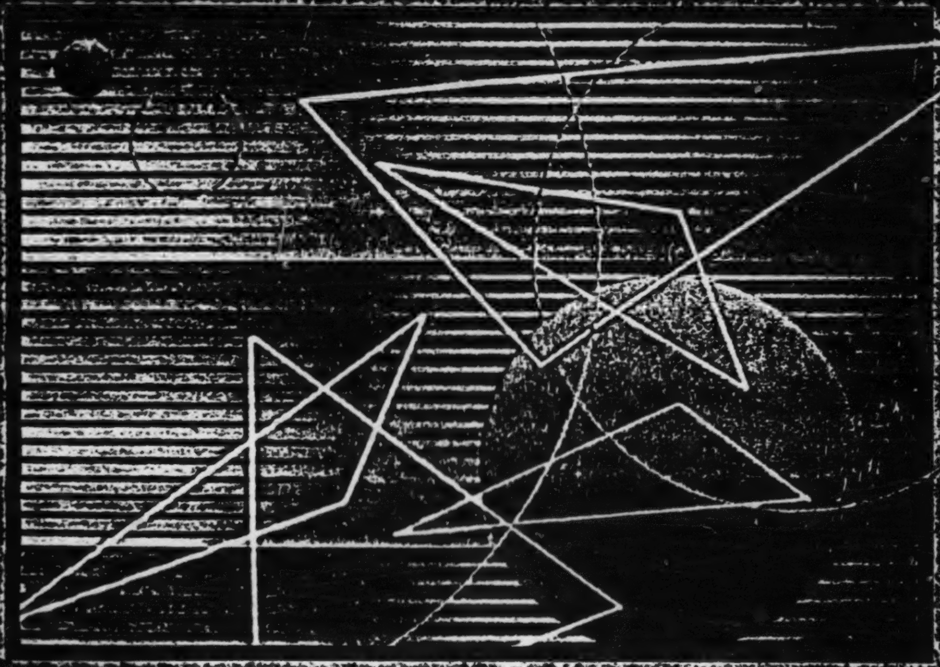
ROUGH-TERRAIN FORK-LIFT SAFETY TRAINING MANUAL

by
MAC TERRY

MASON CONTRACTORS ASSOCIATION OF AMERICA
17W601 - 14th STREET
OAKBROOK TERRACE, ILLINOIS 60181
AREA CODE 312/620-6767

136

TRADE AND TECHNICAL EDUCATION CATALOG



BEST COPY AVAILABLE

CONSTRUCTION AND CIVIL TECHNOLOGY

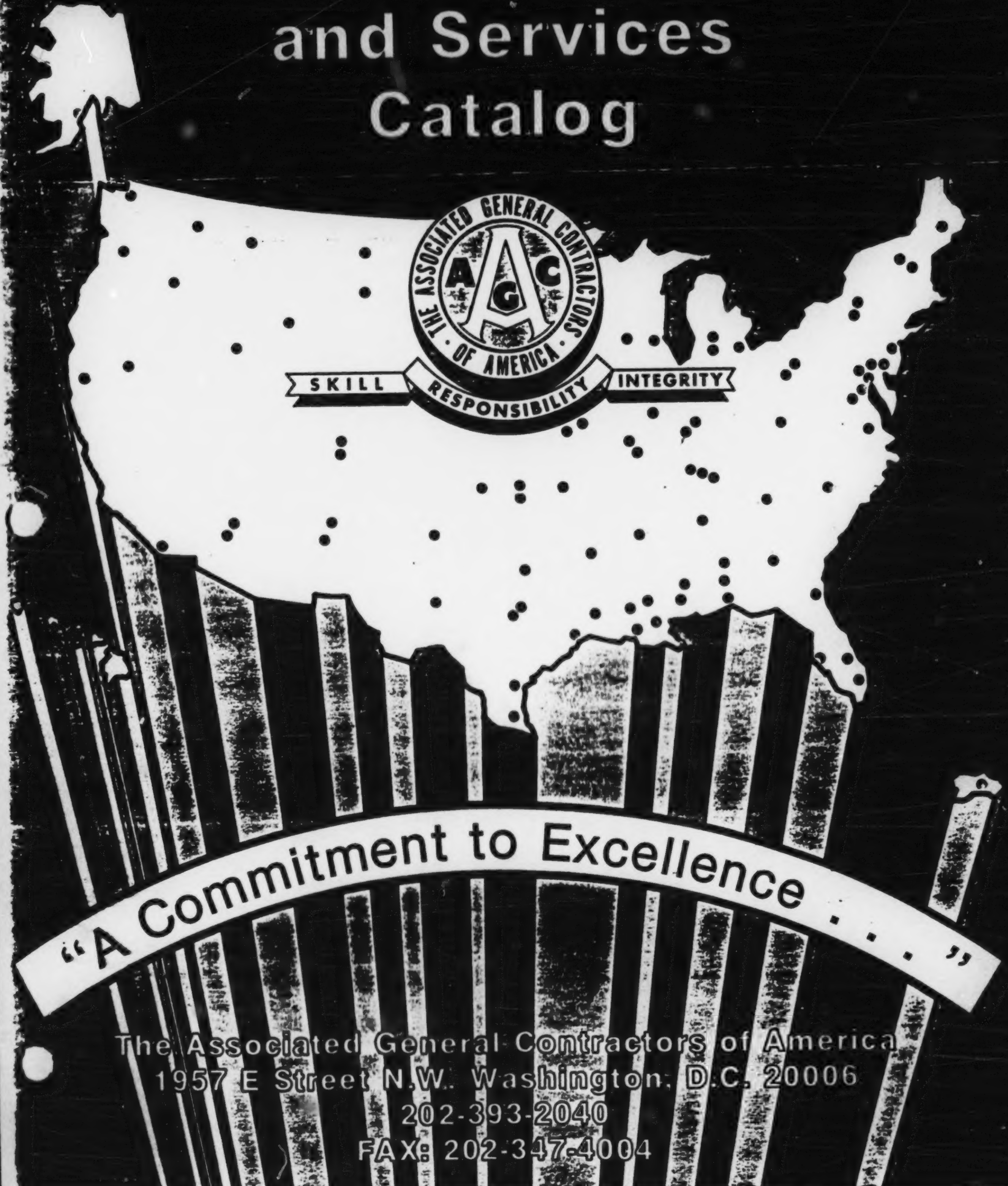
1989

McGraw-Hill

[illegible]

[illegible]

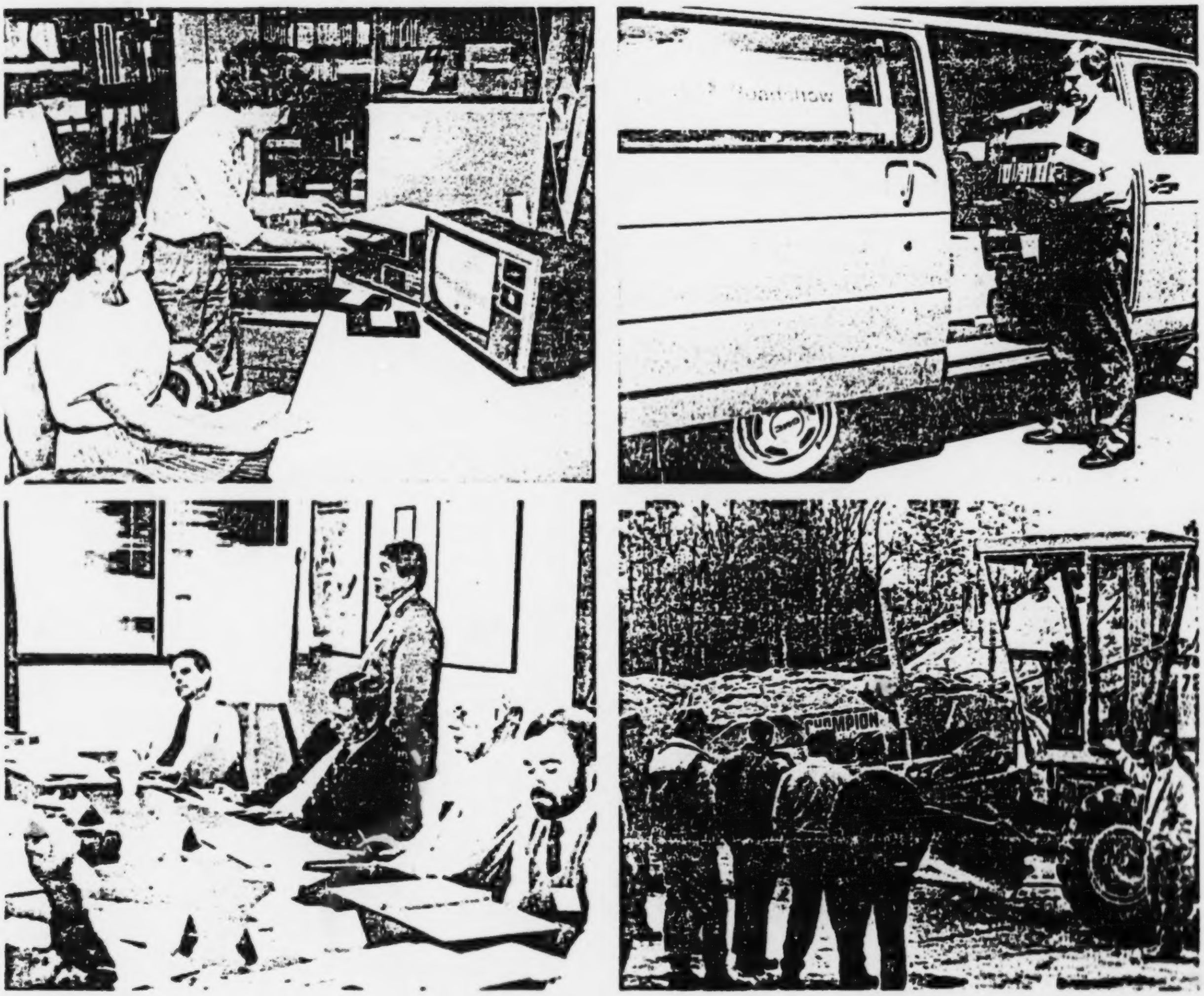
1988-89
AGC Publications and Services Catalog


THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
A G C
SKILL
RESPONSIBILITY
INTEGRITY
"A Commitment to Excellence . . ."

The Associated General Contractors of America
1957 E Street N.W. Washington, D.C. 20006
202-393-2040
FAX: 202-347-4004

U.S. Department
of Transportation
**Federal Highway
Administration**

State and Local Highway Training and Technology Resources



RT-88-001

July 1988

Research, Development and
Technology
National Highway Institute

SANDERSON SAFETY SUPPLY CO.

CORPORATE HEADQUARTERS, WAREHOUSE & STORE,
1101 S.E. Third Ave., Portland, OR 97214 (503) 238-5700 **Oregon Toll Free 1-800-452-9955**

EUGENE AREA STORE
850 Conger Street
Eugene, Oregon
(503) 683-9333

BOISE, IDAHO OFFICE
(208) 343-1323
Or Toll Free
1-800-547-0927

SEATTLE, WASHINGTON OFFICE
(206) 244-9876
Or Toll Free
1-800-547-0927
SEATTLE/TACOMA
(206) 272-4519

DENVER, COLORADO OFFICE
3400 Blake Street
Denver, Colorado
(303) 296-1000

Asbestos Removal Products

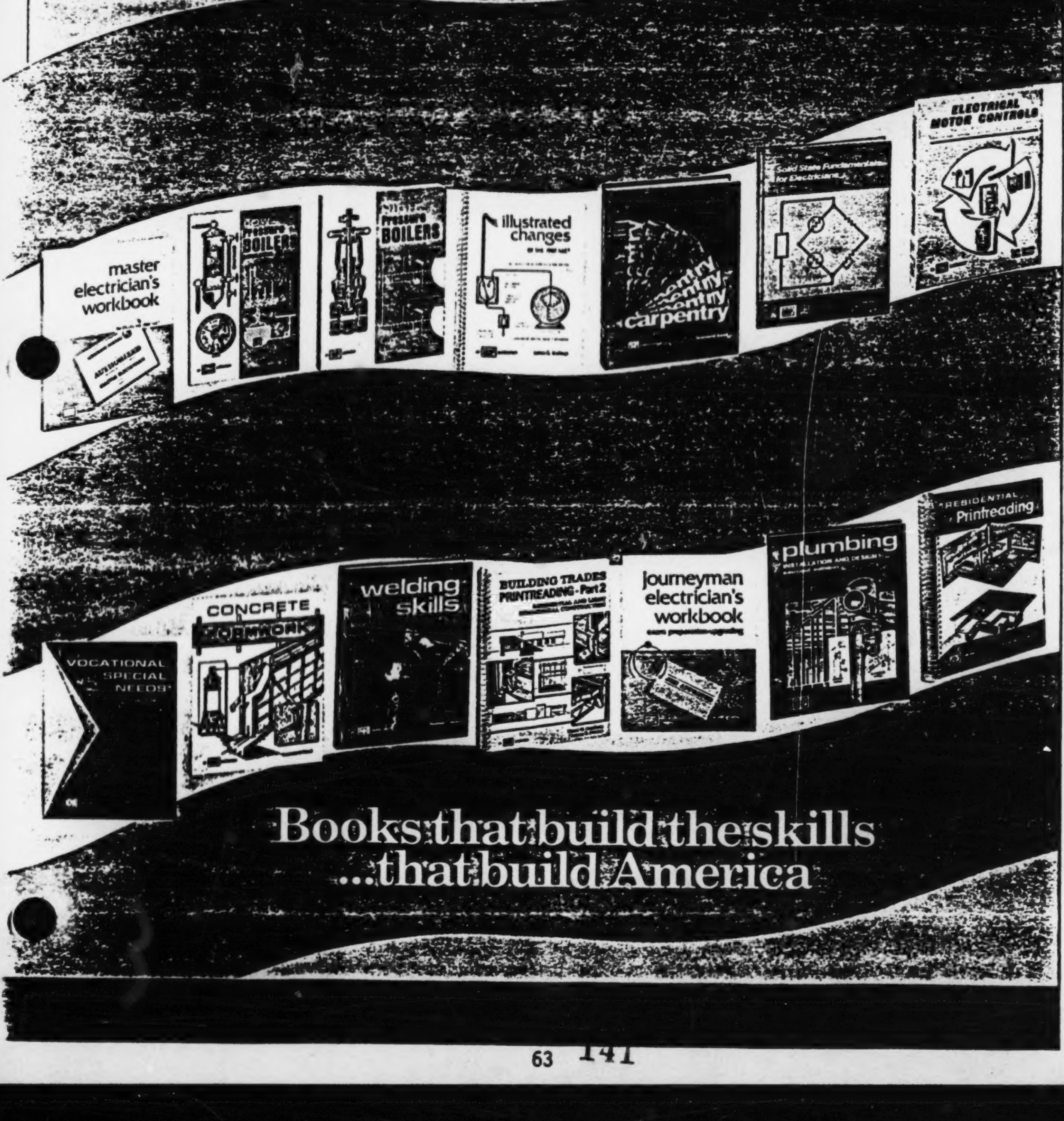
1916 SANDERSON SAFETY SUPPLY CO. 70th 1986

AMERICAN TECH

atp

1987 catalog

To order or review any book in this catalog, write or call toll free.


master electrician's workbook
BOILERS
Pressure BOILERS
illustrated changes
carpentry
Solid State Fundamentals for Electricians
ELECTRICAL MOTOR CONTROLS
VOCATIONAL SPECIAL NEEDS
CONCRETE FORMWORK
welding skills
BUILDING TRADES PRINTREADING - Part 2
Journeyman electrician's workbook
plumbing
INSTALLATION AND DESIGN
RESIDENTIAL Printreading
Books that build the skills
...that build America

Curriculum Outline

Hours

1 **INTRODUCTION:**
outline school policies, explain need for safety.

3 **EXPLOSIVE TYPES:**
prills, dynamites, water gels, slurry; characteristics of each, including special explosives, binary and prepared charges.

1.5 **BLASTING CAPS:**
electric and non electric, internal construction, function, fuse liters and safety fuse, proper capping.

1.5 **DETONATING CORD:**
all types of detonating cord, uses, advantages, characteristics, trunk lines, tails, knots, mms delays.

1 **TOOLS AND EQUIPMENT:**
crimpers, blasting galvanometers, blasting detonators and the use of.

1 **EXPLOSIVE SAFETY I:**
common sense, two man rule, smoking areas, etc.

8 **PRACTICAL APPLICATION:**
use of blasting caps, tools and equipment.

4 **ELECTRIC FIRING TECHNIQUES:**
series and series parallel circuits, OHMS law, circuit calculations, wiring techniques, applicable math formulas.

2 **PRIMING (LOADING):**
loading of all types, small and large diameter holes, deck loading.

4 **PATTERNS:**
theory ot rock breakage, types of patterns, loading calculations, selection of patterns.

3 **CONSTRUCTION/ CONTROLLED BLASTING:**
trenching, leach fields, basements, block holing, control methods, tight shots, tamping.

2.5 **EXPLOSIVE SAFETY II:**
static electricity, personnel control, shot security, do's and don'ts, explosive fires, disposal methods.

2 **VIBRATION:**
monitor techniques, USBM and OSM standards, pounds per detonation vs. scaled distance.

1 **AIR BLAST:**
monitor techniques, USBM and OSM standards.

8 **PRACTICAL APPLICATION:**
loading of bore holes, series and series parallel hook ups, detonating cord hook ups, team problems, safety exercise, field calculations.

2.5 **DRILLING TECHNIQUES:**
use of hand drill, drill truck, air and hydraulic track.

2 **DRILL MAINTENANCE:**
physical breakdown of hand drill for repairs, proper care and cleaning.

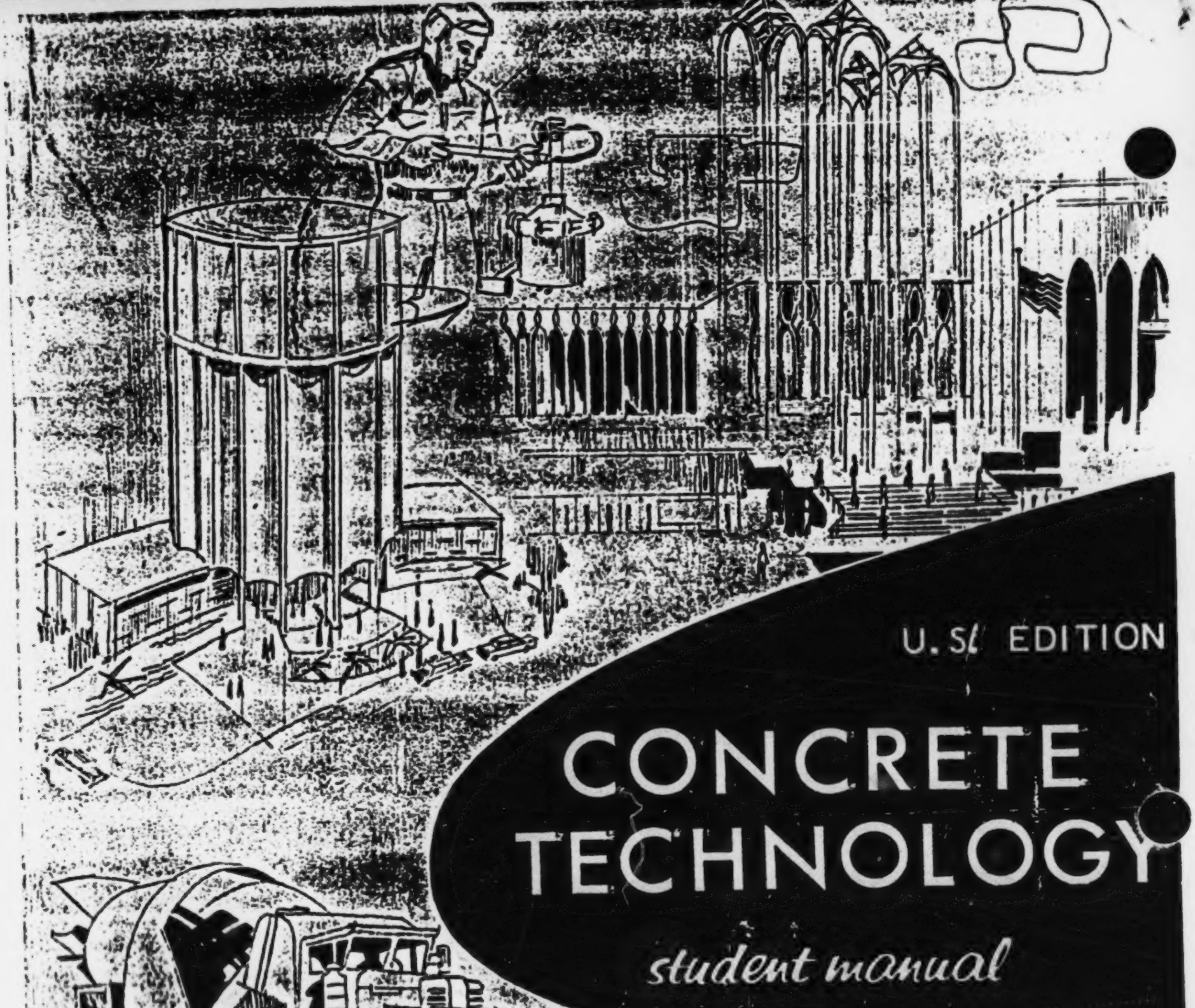
1 **TRANSPORTATION, STORAGE and HANDING:**
federal, state and local regulations.

NOISE
CONTROL

A guide for
workers and employers

U.S. Department of Labor

Occupational Safety and
Health Administration



U.S. EDITION

CONCRETE TECHNOLOGY

student manual

DELMAR PUBLISHERS ALBANY, NEW YORK

STAFF TRAINING

CURRICULUM DEVELOPMENT
OUTLINE FOR CONSTRUCTION PROGRAMS

1. *Table of Contents*

   List all major contents of a given program

   Include: course objectives, instructor objectives, curriculum outline, equipment list, books and printed material, audiovisual programs and program evaluation outlines.

2. *Course Objectives*

   a. A short general overview of the program and what will be taught.

3. *Instructor Objectives*

   a. A short description of each major component of the program and its importance as a training objective.

4. *Curriculum Outline*

   a. An estimate of when and what sequence the major components will be taught.

      NOTE: Instructors to keep a detailed record of what is taught and in what sequence. Instructor recommendations given to modify teaching sequence or additions or subtractions to the course curriculum.

5. *Equipment List*

   This is a detailed list of every item needed to conduct the program. It includes equipment tools or construction materials. This becomes a check list for future preplanning of classes.

6. *All Printed Resource Materials Listed*

   This includes books, brochures, handouts, reference articles, charts, graphs, manufacturer data sheets, maintenance manuals, blueprints, etc.

7. *Audiovisual Materials*

   Break down into films, VCR, slides or overlays.

   NOTE: The equipment for the utilization of these materials will be listed under equipment.

APPENDIX A
CURRICULUM DEVELOPMENT
OUTLINE MODEL

CONCRETE PROGRAM

TABLE OF CONTENTS

1. COURSE OBJECTIVIES
2. INSTRUCTOR OBJECTIVIES
3. CURRICULUM OUTLINE
4. EQUIPMENT LIST
5. RESOURCE MATERIAL
   - A. Books and Printed Material
   - B. Audio Visual - Films and slides
6. TOOL NOMENCLATURE
7. INTRODUCTION TO CONCRETE
   - A. Concrete Floor Construction
     - 1. Planning
     - 2. Excavation and compaction
     - 3. Forming
     - 4. Placing
     - 5. Finishing
     - 6. Curing
     - 7. Stripping
     - 8. Clean-up
8. CONCRETE BURNS
9. HAND SIGNALS
10. AIR AND POWER TOOLS
    - A. Soil Compaction and Equipment
    - B. Pavement Breaker and Air Safety
    - C. Sandblasting Equipment
    - D. Chipping Guns and Grinders
    - E. Concrete Vibrators
    - F. Concrete Saws
    - G. Concrete Core Drills
    - H. Dry Pack Gun
11. APPENDIX

    KAISER CONCRETE TOPICS - (Basic Class)
    - A. No. 5 - Curing Materials
    - B. No. 12A Field Testing (slump)
    - C. No. 13 Vibration and Revibration
    - D. No. 25 Pumping of Concrete
    - E. No. 32 Placing of Concrete
    - F. No. 34 Control Joints
    - G. No. 35 Factors Influencing Quality Control
    - H. No. 42 Repair of Concrete
    - I. No. 44 Estimating Concrete
    - J. No. 48 Concrete Terms
    - K. No. 49 Concrete Terms
    - L. No. 54 Release Agents For Forms
    - M. Cement - Water Ratio

NOTE: The kaiser Topics will be used in both this basic program as well as the foreman program. In the basic concrete program only a limited number of Kaiser Topics will be used. The foreman class will continue to be taught with the Laborers - A.G. C. format.

CONCRETE TECHNOLOGY

COURSE OBJECTIVE

THE OBJECTIVE OF THIS COURSE IS TO ESTABLISH A STANDARD FOR PLACING CONCRETE THAT WILL NOT VARY FROM JOB TO JOB. IT SHOULD ALSO PREPARE THE PARTICIPANT TO ACCEPT A JOB REFERRAL AND FEEL CONFIDENT ENOUGH AND SURE ENOUGH OF HIMSELF TO ACHIEVE MAXIMUM SAFETY AND PRODUCTIVITY FOR THE EMPLOYER.

IT IS PROVEN THAT THE CONSTRUCTION INDUSTRY IS, AT BEST, A DANGEROUS JOB. FOR THAT REASON, TOTAL SAFETY HABITS HAVE TO BE PRACTICED TO MAINTAIN PROPER WORKING CONDITIONS FOR A SAFE BUT EFFICIENT OPERATION AT THE JOB SITE.

THIS COURSE WILL BEGIN IN THE CLASSROOM AND COMPLETE WITH HANDS-ON TRAINING. THIS WILL INSURE THAT THE PARTICIPANT WILL FIRST LEARN THE PROPER MATERIALS AND MIXING PROCEDURES OF CONCRETE. THE PARTICIPANT WILL THEN BE ABLE TO APPLY THE ACTUAL HANDS-ON PLACING AND PROPER CARE TO THE CONCRETE TO ACHIEVE THE MAXIMUM STRENGTH AND APPEARANCE OF A COMPLETED PROJECT.

INSTRUCTOR OBJECTIVES

1. PLANNING
PLANNING IS THE KEY TO ALL PHASES OF CONCRETE PLACING FROM EXCAVATION, FORMING, PLACING, FINISHING, CURING, STRIPPING, AND CLEAN-UP TO MAINTAIN A SMOOTH AND EFFICIENT COURSE FROM START TO COMPLETION.

2. EXCAVATION
TO TEACH THAT PROPER EXCAVATION AND COMPACTION IS REQUIRED TO ASSURE THE CORRECT INSTALLATION OF FORMS.

3. PORING
TO TEACH PROPER INSTALLATION OF FORMS TO ASSURE TOP QUALITY APPEARANCE AND STRENGTH OF A COMPLETED POUR.

4. PLACING
TO TEACH THE PROPER PROCEDURE OF PLACEMENT OF CONCRETE TO MINIMIZE ANY FORM MOVEMENT OR BREAKAGE WHILE CONCRETE PLACEMENT IS IN PROGRESS.

5. FINISHING
ONCE CONCRETE IS PLACED PROPER FINISHING IS REQUIRED TO REVEAL TRUE STRENGTH AND APPEARANCE OF FINISHED PRODUCT.

6. CURING
AFTER FINISHING IS COMPLETED THE PROPER CURING IS TAUGHT TO RECEIVE PROPER STRENGHT AND APPEARANCE AND TO MAINTAIN THIS AFTER PRODUCT IS FINISHED.

7. STRIPPING
PROPER STRIPPING IS TAUGHT TO LESSEN (MINIMIZE) ANY DAMAGE TO A COMPLETED CONCRETE POUR.

8. CLEAN-UP
CLEAN-UP IS MAINTAINED THROUGH-OUT THIS COURSE TO ASSURE PREVENTION OF ACCIDENT AND ALLOW GOOD WORKING CONDITIONS. FINAL CLEAN-UP IS VERY IMPORTANT TO BE ABLE TO MAINTAIN CONCRETE IN A FINISHED STATE UNTIL FINAL STRENGTH AND APPEARANCE HAS BEEN ACQUIRED.

CONCRETE TECHNOLOGY CURRICULUM

FIRST WEEK

MONDAY

10:00 A.M. - 11:00 A.M.
A. Introductions
B. Camp Rules and Regulations
C. Hand out Books
D. Class Schedule

11:00 A.M. to 12:00 P.M.
A. Film movie - "Friendly Enemy"
B. Discussion of movie

12:00 P.M. - 1:00 P.M.
Lunch

SESSION I

1:00 P.M. to 1:45 P.M.
A. Introduction
B. Course Outline
C. Materials
D. Water

1:45 P.M. to 3:15 P.M.
Classroom Work
A. Topics - 3, 32, 4 and 8
B. Review 48 and 49
C. Questions on Topics

3:15 P.M. to 3:45 P.M.
Field Observation

3:45 P.M. to 5:00 P.M.
A. P.C.A. Film "Transporting and Placing Quality Concrete"
B. Questions on film

TUESDAY

SESSION II

8:00 A.M. to 9:15 A.M.
Classroom Work
A. Topics 20,13,25
B. Questions on Topics

9:15 A.M. to 11:00 A.M.
A. Review of Concrete Vibration Manual
B. Laborers - A.G.C. film: "Concrete Vibration"
C. Questions on film

SESSION III

11:00 A.M. to 12:00 P.M.
Classroom work
A. Topics 23,55,34,and 5
B. Questions on topics

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 2:00 P.M.
A. P.C.A. Film: "Finishing and Curing Quality Concrete"
B. Questions on film

SESSION IV

2:00 P.M. to 3:30 P.M.
Classroom work
A. Topics 1,2,12a, and 56
B. questions on topics

3:30 P.M. to 5:00 P.M.
Field observation

WEDNESDAY 8:00 A.M. to 9:00 A.M.
Use of technical manuals

SESSION V

9:00 A.M. to 9:45 A.M.
Classroom work
A. O.S.H.A. 301- Pages 9,10,12, and 13
B. O.S.H.A. Slides

9:45 A.M. to 11:00 A.M.
A. Laborers-A.G.C. Film "Working at Heights Safely"
B. Questions on Film
C. "Whats In It For Me" brochure

SESSION VI

11:00 A.M. to 12:00 P.M.
Classroom Work
A. Topics 17,9,7, and 42
B. Questions on film

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 1:30 P.M.
A. Finish topics 17,9,7, and 42
B. Questions

1:30 P.M. to 2:30 P.M.
Waddell slides

SESSION VII - A

2:30 P.M. to 3:30 P.M.
A. Classroom Work Topic 44
B. Questions on Topic
C. Teach use of concrete calculator (sliderule)

SESSION VII - B

3:30 P.M. to 5:00 P.M.
A. Classroom Work Topic 35
B. Questions on Topic
C. Pre, During and Post Pour

THURSDAY SESSION VIII

8:00 A.M. to 10:00 A.M.
Tool Identification
10:00 A.M. to 12:00 P.M.
Walk through tool list and all on site materials

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 4:00 P.M.
"Hands-on" - small forming, mixing, placing, and vibrating of concrete projects and proper curing procedures

4:00 P.M. to 5:00 P.M.
A. Clean-up
B. Storage of all tools

FRIDAY 8:00 A.M. to 10:00 A.M.
A. General Review and discussion of classroom and hands-on

10:00 A.M. to 12:00 P.M.
A. Hand out and preview Red Cross Multi-Media and First Aid booklets

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 2:30 P.M.
Clean-up class rooms and living quarters

2:30 P.M.
Dismissed for weekend

CONCRETE TECHNOLOGY CURRICULUM

SECOND WEEK

MONDAY

10:00 A.M. to 12:00 P.M.
General Discussion and Set-up for hands-on project.

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 4:00 P.M.
"Hands-on project" - excavation, fine grade, and set forms for project.

4:00 P.M. to 5:00 P.M.
A. Clean-up
B. Discussion of days progress

TUESDAY

8:00 A.M. to 12:00 P.M.
"Hands-on" - Set-up, placing, vibrating concrete wall and proper curing procedure

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 5:00 P.M.
"Hands-on" - excavation, compacting, and forming curb and gutter and sidewalks

WEDNESDAY

8:00 A.M. to 10:00 A.M.
"Hands-on" - set-up, placing, vibrating concrete for curb and finish

10:00 A.M. to 12:00 P.M.
"Hands-on" - strip and dry pack and clean-up

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 4:00 P.M.
Place, vibrate, screed, float and finish flat work and proper curing of flat work section A and C

4:00 P.M. to 5:00 P.M.
Clean-up and store tools

THRUSDAY

8:00 A.M. to 12:00 P.M.
Multi-Media First Aid

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 5:00 P.M.
Multi-Media First Aid

FRIDAY

8:00 A.M. to 12:00 P.M.
General discussion and review of course

12:00 P.M. to 1:00 P.M.
Lunch

1:00 P.M. to 2:30 P.M.
Clean classroom and living quarters

2:30 P.M.
Class dismissed

CONCRETE PROGRAM
EQUIPMENT LIST
(IN ORDER)

PLANNING

Blueprints or job sketches

EXCAVATION

First aid kit
Hard hat and gloves
Shovels - square point and round point
Pavement breaker (with hose and bits) and safety glasses
Compressor
Compactors
Roller and vibrator
Water hose and nozzel
Tripod and level or transit and grade rod
Backhoe (580-Case)
Dumptruck
Wheelbarrow
Pick-up

FORMING

Plywood
2 X 4's/2 X 6's
Hammers (claw)
Wood stakes
Steel stakes
Skill saw
Extension cord
Hand saw
Table saw
Handpump can (form oil)
Rebar or mesh
Measure tape
Snap ties
Side cutters
Crescent wrench
Wrecking Bar

CONCRETE PROGRAM

EQUIPMENT LIST

Cont.

PLACING CONCRETE

- Concrete slide rule
- Rubber gloves
- Slump cone
- Mixer
- Vinegar
- Pump can (curing compound)
- Plastic
- Electric vibrators 3"/1½"/1"
- 1½" air vibrator
- Shovels
- Concrete hoe
- Straight edge and rod
- Knee pads
- Power buggy

FINISHING

- Edger
- Fresno w/handle
- Coloring
- Magnesium bull float w/handles
- Jitterbug
- Knee boards
- Steel trowels
- Rubber floats
- Grinder
- Magnesium and wood hand floats
- Darby
- Concrete broom and handle
- Jointer
- Power trowels
- Moose milk
- Sand, gravel, coloring
- Buckets
- Concrete saw/blades
- Core drill
- Portland cement
- Dry-pack gun
- Sandblaster - pot and helmet

Cont.

STRIPPING/BACKFILL/CLEAN-UP

- Single and double jacks
- Form scrapers
- Diesel for forms
- Wire brushes
- Nail puller

NOTE: In many cases the tools listed can and will be used in several or all phases from start to completion but for this list, we have only listed them once in the most likely order of use.

CONCRETE PROGRAM

BOOKS AND PRINTED MATERIALS

KAISER CONCRETE TOPICS
WADDELL CONCRETE CONSTRUCTION HANDBOOK
CONCRETE PRIMER - ACI
CONCRETE MANUAL - PUBLIC WORKS
ACI MANUAL OF CONCRETE PRACTICES
CONCRETE VIBRATION
CEMENT MASONS MANUAL
CONCRETE FLOOR CONSTRUCTION
TIPS ON CONTROL TEST FOR QUALITY CONCRETE
REMOVING STAINS - P.C.A.
CONCRETE INSPECTION MANUAL - WADDELL
PAVEMENT BREAKER AND AIR SAFETY
90 - POUND PAVEMENT BREAKER
CHIPPING GUNS AND GRINDERS
CONCRETE SAWS
PNEUMATICALLY PLACED PORTLAND CEMENT
CONCRETE CONSTRUCTION MAGAZINE
CEMENT MASONS GUIDE
DESIGN AND CONTROL OF CONCRETE MIXTURES
BURNING FACTS

CONCRETE PROGRAM

AUDIO VISUAL MATERIALS

FILMS

TRANSPORTING AND PLACING OF CONCRETE
CONCRETE VIBRATION
FINISHING AND CURING
WORKING AT HEIGHTS SAFELY
FRIENDLY ENEMIES
YOUR ATTITUDE IS SHOWING

AUDISCAN

MECHANICS OF LIFTING
CONCRETE SAWS
CHIPPING GUNS AND GRINDERS

SLIDES

O.S.H.A. SLIDES - SAFETY
WADDELL SLIDES - COMMON AND RECURRING PROBLEMS IN CONCRETE

HOD AND MASON TENDING PROGRAM
EVALUATION CHECKLIST

EQUIPMENT AND TOOLS

1. Is all the needed equipment available? Yes____ No______
2. Is the available equipment of a realistic quality for training? Yes_____ No______
3. Recommendations (if any)____

____

____

____

PERSONAL PROTECTIVE EQUIPMENT

1. Is the necessary protective equipment available? Yes____ No_____
2. Was the protective equipment being properly used? Yes____ No_____
3. Do the trainees seem safety conscious? Yes____ No______
4. Recommendations (if any)____

____

____

____

MATERIALS

1. Are all the needed supplies available (block, lime, etc.)? Yes_______ No_______
2. Are the quality of supplies sufficient? Yes____ No______
3. Do the trainees seem safety consious? Yes_____ No________
4. Recommendations (if any)____

____

____

____

CURRICULUM

1. Are there topics that need to be added to the curriculum? Yes_______ No_________
2. Are there topics that need to be deleted from the curriculum? Yes_______ No_________
3. Should the sequence of insturction be modified? Yes____ No_____
4. Does the length of the program appear to be too short- Yes____ No_____, or too long? Yes______ No______
5. Recommendations (if any)____

____

____

____

HOD AND MASON TENDING PROGRAM
EVALUATION CHECKLIST

Cont. (page 2)

AUDIO VISUAL INFORMATION

1. Are there other materials that should be introduced? Yes______ No_____ If yes, what are the sources of material?
   ____
   ____
   ____
2. Recommendations (if any)____
   ____
   ____
   ____

TRAINEE INTERVIEW

1. Does the trainees attitude toward physical work appear to be good? Yes_______No_______
2. Do the trainees seem to feel confident with what they have learned? Yes______No________
3. Does it appear that the trainees have obtained sufficient skills for beginning as a hod carrier/mason tender? Yes_____No________
4. Recommendations (if any)____
   ____
   ____
   ____

CURRICULUM OUTLINE MODEL
HOD AND MASON TENDING PROGRAM

First Week

Monday, 9:00 a.m. - 12:00

- Introduction
- Program Overview
- Applications
- Hand-Out Books
- Discussion of Book
- AGC Safety Film

1:00 p.m. - 4:00 p.m.

- FS-21 Mason Tending and Forklift Safety Film
- Math Test
- Introduction to Mixer--Hands-on Demonstration
  - Types of mixers
  - Maintenance
  - Starting gas mixers
  - Mixer safety
  - Transporting of mixers
- Introduction/Demonstration of Mason Saws
  - Types of saws
  - Safety operation
  - Types of blades
- Introduction to Scaffolding
  - Kwik stage
  - Masonry scaffolding
  - Carpenter or safeway scaffolding

NOTE: If any time is left, put up one section of masonry scaffolding by instructor to show how to do it and that it can be done by one person.

Tuesday, 8:00 a.m. - 12:00

- F8--Working at Heights Safety Film
- Study--Safety Rules of Scaffolding
  - OSHA Code
- Kwik Stage Scaffolding
  - Practice setting up and taking down
  - Balancing and leveling
- Safeway Scaffolding
  - Practice setting up and taking down
  - Blacking and leveling
- Masonry Scaffolding
  - Practice setting up and taking down
  - Blacking and leveling
- Scaffolding Patterns
  - Three wide
  - Three high

First Week, Tuesday
Continued

1:00 p.m. - 5:00 p.m.

- Forklift Operation
  - Maintenance check
  - Operation demonstration
  - Forklift safety film
  - Study--Rough terrains forklift Safety training manual
  - Students practice forklift operation

Wednesday, 8:00 a.m. - 5:00 p.m.

- Review Forklift Safety
- Project Initiation
  - Rotation of students
    - Mixing mortar
    - Building scaffolding
    - Cutting of bricks
    - Forklift operation
    - Clean up and storage of equipment

Thursday, 8:00 a.m. - 5:00 p.m.

- First Aid and CPR

Friday, 8:00 a.m. - 12:00

- Compressor
  - Maintenance
  - Operation
- Pavement Breaker and Chipping Gun
  - Safety equipment
  - Maintenance
  - Operation

1:00 p.m. - 4:00 p.m.

- Break and Chip Concrete
- Clean Up and Storage of Equipment

Second Week

Monday, 8:00 a.m. - 12:00

- Review of Safety from Previous Week
  - Scaffolding
  - Forklift operation
  - Mortar mixing
  - Brick saw operation
- Hand Mix Mortar with Color Additive

Second Week, Monday
Continued

1:00 p.m. - 5:00 p.m.

Project Development
  Rotate Students on:
    Scaffold building
    Forklift operation
    Mortar mixing
    Brick saw operation
    Clean up and storage of equipment

Tuesday, **8:00 a.m. - 12:00**

Scaffolding Slide Show
Forklift Training Manual
Introduction of Grout Pump
Introduction to Oxyacetylene Cutting
Project Development--Student Rotation
  Scaffold building
  Forklift operation
  Brick saw operation
  Mortar mixing
  Cutting torch

1:00 p.m. - 5:00 p.m.

Project Development (continued)
  Scaffold building
  Forklift operation
  Brick saw operation
  Mortar mixing
  Cutting torch

Related Instruction
  How to place mortar overhead
  Other types of snap ties
  Use of multiple colors in mortar
  Working at extreme heights
Clean Up and Equipment Storage

Wednesday, **8:00 a.m. - 5:00 p.m.**

Black Distribution and Calculations
Signaling
Construction Project
  Continuation of construction project--rotating students in each major category.
Clean Up--Equipment Storage

Thursday, 8:00 a.m. - 12:00

- Continuation of Construction Project
- Clean Up

1:00 p.m. - 5:00 p.m.

- Student Evaluation
  - Operating forklift
  - Construction of scaffolding under time and accuracy standards
  - Quality of mortar mixed
- Clean Up and Equipment Storage

Friday, 8:00 a.m. - 5:00 p.m.

- Student Evaluation
  - Block calculations
  - Types of blocks
  - Hand signals
  - Types of scaffolding
  - Safety test

- Program Evaluation
- Graduation

DO:nw
CDG-115

APPENDIX B

APPENDIX B
STANDARDS OF APPRENTICESHIP

STANDARDS of APPRENTICESHIP

adopted by

Sponsor/Employer ____

____
Address City State ZIP

For the skilled occupational objective(s) of:

MINER

____

Registered with:

Bureau of Apprenticeship and Training
U. S. Department of Labor
Boise, Idaho

____
Date

Revised ____________________

____

____

____

PURPOSE and POLICY

Parties signatory to the following Standards of Apprenticeship declare their purpose and policy to be that of establishing and sponsoring an organized system of apprenticeship training. The Standards are in conformity with Federal Labor Standards (29 CFR 29), which govern employment and training in apprenticeable occupations.

DEFINITIONS

Apprentice shall mean a person at least sixteen (16) years of age, who has signed a written Apprenticeship Agreement with a Sponsor to learn an apprenticeable occupation, as outlined in these Standards.

Journeyman shall mean an individual who has sufficient skills and knowledge of a trade, craft, or occupation, either through formal apprenticeship training or through practical on-the-job work experience, to be recognized by a State or Federal registration agency and/or an industry as being fully qualified to perform the work of the trade, craft, or occupation.

Apprenticeship Agreement shall mean a written agreement between an apprentice and the Sponsor, which has been registered with the registration agency.

Sponsor shall mean any person, plant, firm, facility, or organization operating an apprenticeship program and in whose name the program is (or is to be) registered, or approved.

Standards shall mean this entire document, including Addenda, containing specific provisions for operation and administration of the apprenticeship program.

Registration agency shall mean the Bureau of Apprenticeship and Training, U.S. Department of Labor.

SPONSOR RESPONSIBILITIES

The Sponsor shall take necessary steps to rotate the apprentice(s) in the various work processes of the skilled occupation and will require the apprentice(s) to make satisfactory progress in both on-the-job and related instruction, to assure a well rounded, competent worker. The Sponsor shall ensure the apprentice works under and with competent workers skilled in the occupation for which the apprentice(s) is being trained. Adequate training records will be maintained, to show the progress of the apprentice(s) during the full term of apprenticeship.

APPRENTICE RESPONSIBILITIES

The apprentice shall perform, diligently and faithfully, the work of the trade and duties assigned by the Sponsor and/or supervisor, in accordance with the Standards of the program, and work with person(s) to whom assigned, and to maintain such records of work experience and related instruction as required by the apprenticeship program.

The apprentice shall respect the property of the public, Sponsor, supervisor and others, and abide by the working rules and regulations of the Sponsor. Safe working habits are to be developed and observed, so as to assure their own safety as well as the safety of co-workers.

TERM of APPRENTICESHIP

The term of apprenticeship (not less than 2,000 hours of work experience in each occupation identified in these Standards as apprenticeable) shall be stated in hours or months and shall include the probationary period. The Sponsor may accelerate, by an evaluation process, the advancement of apprentices who demonstrate unusual abilities and mastery of the occupation, to the level for which they are qualified. (See Addendum)

WORK PROCESSES

An outline of the Work Processes in which the apprentice will receive supervised work experience and training on the job and the allocation of the approximate time to be spent in each major process shall be set forth in these Standards. (See Addendum)

RELATED INSTRUCTION

The apprentice shall attend related instruction classes a recommended 144 hours per year, when available. When not available, correspondence courses, or home study courses, or a combination of classroom and home study courses of equivalent value, will be substituted. In case of failure on the part of any apprentice to fulfill this obligation, the Sponsor shall have authority to withhold their periodic wage advancement, suspend or revoke the Apprenticeship Agreement. Time spent in related instruction classes shall not be considered as hours of work, and the apprentice shall not be paid for time so spent, unless related instruction is required during the regular hours of work.

APPRENTICE WAGES and WAGE PROGRESSION

A progressively increasing schedule of wages shall be paid to the apprentice, consistent with the skill acquired. The entry wage shall be not less than the minimum wage prescribed by the Fair Labor Standards Act, where applicable, unless a higher wage is required by other applicable Federal law, State law, respective regulations, or by collective bargaining agreement.

A progressively increasing schedule of wages, in percentages, is recommended, indicated in hours or monthly periods to be set by the Sponsor. (See Addendum)

PERIODIC REVIEW, EVALUATION and MAINTENANCE of PROGRESS RECORDS

It shall be the duty of the Sponsor to periodically review and evaluate apprentices, before advancement to their next progression period. The basic evidence of such advancement shall be the record of the apprentice's progress on the job and during related instruction. If such progress is not satisfactory, the Sponsor shall have the right to withhold their periodic wage advancements, suspend or revoke the Apprenticeship Agreement, or make such recommendations it feels desirable. A recordkeeping system shall be established by the Sponsor for such purposes.

RATIO of APPRENTICES

As determined by the Sponsor, a numeric ratio of apprentices to journeymen shall be included in these Standards. It shall be consistent with proper supervision, training, safety, continuity of employment, and applicable provisions in collective bargaining agreement, if any; EXCEPT where such ratios are expressly prohibited by collective bargaining agreement. The ratio language shall be specific and clear as to application in terms of job site, work force, department or plant. Reasonable exceptions to the ratio may be made, at the discretion of the Sponsor. (See Addendum)

PROBATIONARY PERIOD

All apprentices are subject to a probationary period (to be determined as reasonable to the full apprenticeship term), for which they shall receive full credit toward completion of apprenticeship. (See Addendum) During the probationary period, the Apprenticeship Agreement may be terminated by either the Sponsor or apprentice, without the formality of a hearing or stated cause. After the probationary period, the apprentice may be cancelled for causes deemed adequate and so indicated to the registration agency.

172

SAFETY and HEALTH TRAINING

Sponsor shall instruct the apprentice in safe and healthful work practices and shall ensure that apprentice is trained in facilities and other environments that are in compliance with applicable Federal standards or State standards that have been found to be at least as effective as Federal standards.

MINIMUM QUALIFICATIONS

The Sponsor shall establish minimum qualifications for persons entering the apprenticeship program. All minimum qualifications must be clearly stated and directly related to job performance, with an eligible starting age of not less than sixteen (16) years of age. (See Addendum)

APPRENTICESHIP AGREEMENT

Each apprentice (and, if under eighteen (18) years of age, the parent or guardian) shall sign an Apprenticeship Agreement with the Sponsor, who shall then register such Agreement with the registration agency before employment or attendance at related instruction classes, or within the first thirty (30) days of employment. Following such registration, all signatory parties thereto shall receive copies. Specifically, or by reference, the Apprenticeship Agreement shall incorporate these Standards of Apprenticeship.

The registration agency shall receive timely notice of all dispositions of Agreements, which can be: (1) cancellation; (2) Certificate of Completion; (3) military suspension; (4) suspension.

CREDIT for PREVIOUS EXPERIENCE

Applicants accepted by the Sponsor, who have creditable experience in the skilled occupation or in some other related capacity, may be granted advanced standing as apprentices. Those admitted to advanced standing shall be paid the wage rate for the period to which such credit advances them.

CONTINUITY of EMPLOYMENT

The Sponsor, insofar as possible, will provide continuous employment. In the event of reduction in force, suspended or laid off apprentice(s) will be given the opportunity to return to their apprenticeship before a new apprentice(s) is hired.

SUPERVISION of APPRENTICES

The Sponsor shall assure that apprentices are under the supervision of competent and qualified journeymen on the job, so as to ensure training in all phases of the work. Apprentices shall work the same hours as journeymen, EXCEPT where such hours may interfere with related instruction classes.

CERTIFICATE of COMPLETION

Upon successful completion of apprenticeship, as set forth in these Standards, and passing such examination as the Sponsor may require, Sponsor shall recommend that the registration agency issue a Certificate of Completion of Apprenticeship.

MODIFICATION, CANCELLATION and DEREGISTRATION of PROGRAM

These Standards may be modified or changed, for the betterment of the apprenticeship system, by submitting proposed modification(s) or change(s), in writing, to the registration agency, for approval. If approved, they shall be recorded and acknowledged as an amendment to the program. HOWEVER, such modification(s) or change(s) shall not affect Apprenticeship Agreements then in force, without consent of all parties signatory to the Agreement.

Cancellation and deregistration of the program may be accomplished voluntarily, by a written request from the Sponsor to the registration agency, or by formal deregistration proceedings, under reasonable cause, by the registration agency instituting formal deregistration proceedings in accordance with the provisions of 29 CFR 29.7.

EQUAL EMPLOYMENT OPPORTUNITY in APPRENTICESHIP and TRAINING

Each Sponsor establishing an apprenticeship program under these Standards hereby includes, as part of these Standards, the following Equal Employment Opportunity Pledge:

> *The recruitment, selection, employment and training of apprentices during their apprenticeship shall be without discrimination because of race, color, religion, national origin or sex. The Sponsor shall take affirmative action to provide equal opportunity in apprenticeship and will operate the apprenticeship program as required by Title 29 Part 30 of the CODE OF FEDERAL LABOR STANDARDS.*

Each Sponsor, when applicable (Sponsors with five (5) or more apprentices in any

174

one skilled occupation), shall adopt an Affirmative Action Plan and selection procedures, which shall include goals and timetables, if analysis indicates underutilization of minorities and/or women (minority and non-minority) and conduct, operate and administer this program in conformity with Title 29 CFR Part 30. Such Affirmative Action Plan and selection procedures shall be adopted through a separate document.

DISPOSITION of COMPLAINTS

After completion of the stated probationary period, any difference relative to the Apprenticeship Agreement, which cannot be adjusted by the Sponsor, any affected party may appeal to the registration agency for interpretation of any part of the Standards over which there is a difference. It shall be understood that this provision applies only to problems affecting Apprenticeship Agreements. Parties may avail themselves of the grievance procedure of the collective bargaining agreement, if any.

The registration agency shall be furnished the name and address of the appropriate authority to receive, process and make disposition of complaints.

REGISTRATION AGENCY RECORD REQUIREMENTS

It shall be the responsibility of the Sponsor to establish and maintain such apprenticeship records as may be required by the registration agency and other applicable laws.

SAVINGS CLAUSE

If and when any part of these Standards become illegal, as pertains to Federal and/or State law, that part and that part alone shall become inoperative and null and void. The remainder of the Standards shall remain in full force and effect.

TEMPORARY DISABILITY

An apprentice who is unable to perform the on-the-job portion of apprenticeship training may, if the apprentice so requests, participate in related instruction classes, subject to the apprentice obtaining and providing to the Sponsor written medical approval for such participation. HOWEVER, time so spent will not count toward on-the-job portion of apprenticeship training

TRAINING COORDINATOR - TRAINING DIRECTOR

Sponsor may employ a competent person as a full or part time Training Coordinator/Training Director. Such person shall assume responsibilities and authority for the operation of the program as are delegated by the Sponsor.

CONSULTANTS

Consultants may be asked to participate, without vote, in conferences related to apprenticeship.

ADDENDUM (IND)*

PROBATIONARY PERIOD

All apprentices employed in accordance with these Standards shall be subject to a probationary period not exceeding the first 2,000 hours of the term of apprenticeship.

MINIMUM QUALIFICATIONS

Apprenticeship applicants, before being considered as apprentices, must meet the following: (only checked items apply)

☒ Must be between the ages of 18 and N/A. Exceptions may be made by the Sponsor for those above the age limit, who have creditable experience in the occupation and/or have been in military service. Such exception for military service shall not exceed ______ additional years.

☐ Have a ________ grade education or certified equivalency.

☐ Must have taken and passed all phases of a validated specific aptitude test for the occupation, administered by the local State Employment Service office.

☒ Be physically fit, without regard to any occupationally irrelevant physical handicap.

☐ Other ____

____

____

---

* For each skilled occupational objective listed, include separate attachments: Attachment #1 - TERM of APPRENTICESHIP; APPRENTICE WAGES and WAGE PROGRESSION; RATIO of APPRENTICES; Attachment #2 - WORK PROCESSES

ADDENDUM (D.J)
Attachment #1

Skilled occupational objective: MINER

TERM of APPRENTICESHIP

The term of apprenticeship shall not be less than 2,000 hours of reasonably continuous employment.

APPRENTICE WAGES and WAGE PROGRESSION

Apprentices shall be paid based upon the following percentages of the journeyman wage rate:

1st		period	%	6th		period	%
2nd		period	%	7th		period	%
3rd		period	%	8th		period	%
4th		period	%	9th		period	%
5th		period	%	10th		period	%

As of ______________ (date), the journeyman wage rate for this skilled occupation

is $ ____________ per __________. Should this wage rate be increased during the term of apprenticeship, adjustments in apprentice wages shall be made to reflect stated percentages of the higher journeyman wage rate.

RATIO of APPRENTICES

For 1 (number) journeymen regularly employed, employer ☒ may ☐ shall have

1 (number) apprentice(s) and ☒ may ☐ shall have 1 additional appren-

tice(s) for each 3 (number) journeyman regularly employed thereafter.

939.281-010
0354 AMS

ADDENDUM (INJ)
Attachment #2

Skilled occupational objective: Miner I

WORK PROCESSES*

During the term of apprenticeship, the apprentice shall receive such instruction and experience, in all branches of the occupation, as are necessary to develop a practical and versatile worker. Major processes in which apprentices will be trained (although not necessarily in the order listed) and approximate hours (not necessarily continuous) to be spent in each are as follows:

	WORK PROCESSES	APPROXIMATE HOURS
A.	JACKLEG DRILLING	750
B.	ROCK BOLTING	400
C.	TIMBERING	100
D.	MUCKING MACHINE	500
E.	TRACK REPAIR	50
F.	DRIFTING	50
G.	SLUSHER	50
H.	BALD RAISES	75
I.	MACHINERY MAINTENANCE	25

TOTAL HOURS 2,000

* Use additional sheets, if necessary

ADOPTED and APPROVED:

For the Sponsor/Employer

By ____________________

Title ____________________

Date ____________________

Registered as incorporating the basic
fundamentals recommended by the
Federal Committee on Apprenticeship

By ____________________

Title Regional Director

Date ____________________

Joseph J. Harris
Apprenticeship and Training Representative
Bureau of Apprenticeship and Training
U. S. Department of Labor
Boise, Idaho

APPENDIX C

APPENDIX C
SAFETY

APPENDIX C

How to Select Proper Hearing Protection

Personal hearing protective devices are designed to reduce the amount of sound energy transmitted through the ear canal. The correct type must be selected to perform properly.

Personal hearing-protective devices are acoustical barriers designed to reduce the amount of sound energy transmitted through the external ear canal to receptors in the middle and inner ear.

The sound attenuation capability of a hearing protective device (in decibels) is the difference in the measured level of the threshold of audibility for an observer with hearing protectors in place (test threshold), and the measured hearing threshold when his ears are open and uncovered (reference threshold).

Hearing protection devices in common use today are generally either insert or muff types.

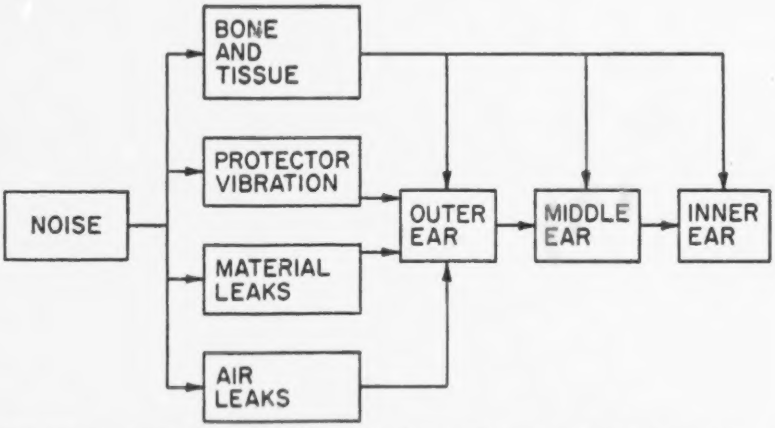
The insert-type protector attenuates noise by plugging the external ear canal, whereas the muff-type protector encloses the auricle of the ear to provide an acoustical seal.

A third type provides a seal at the opening of the external ear canal.

The effectiveness of hearing protective devices depends on several factors that are related to the manner in which the sound energy is transmitted through or around the device.

The accompanying schematic shows four pathways by which sound can reach the inner ear when hearing-protective devices are worn:

- Seal leaks;



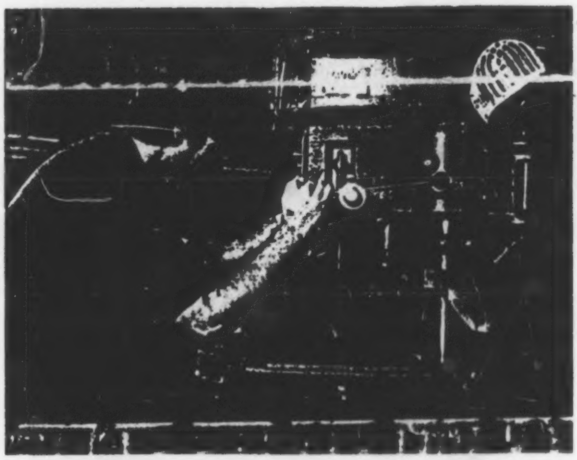
The schematic illustrates how sound follows different methods of reaching the inner ear of a person wearing hearing protection. (From:* Fundamentals of Industrial Hygiene*).

These disposable ear plugs are non-toxic, non-allergenic, and are resistant to natural oils and waxes. They are designed to reduce noise at higher frequencies, while permitting lower speech frequencies to pass through. (Photo: Courtesy of 3M Company.)

This ear plug is disposable or reusable. After use plugs should be washed with mild soap and warm water, rinsed, then squeezed to remove excess moisture. Between uses they should be kept in a container. (Photo: Courtesy of Norton, Safety Products Division.)

Editor's Note: This article has been adapted from Chapter Nine, "Industrial Noise," *Fundamentals of Industrial Hygiene:* Second Edition; 1979; Julian B. Olishifski, P.E., C.S.P., Editor-in-Chief; National Safety Council, 444 N. Michigan Ave., Chicago 60611. Stock No. 151.27. pp. 229-270. $30.

Dispensers must be located throughout plant areas to encourage and facilitate employees in wearing these disposable ear plugs. This type is made of a special mineral fiber, with a thin film of polyethylene plastic, which helps to retain the shape of the devices. The plastic is perforated with microscopic pores to permit the passage of air and moisture, thus eliminating the uncomfortable feeling of pressure or vacuum in the ears. (Photo: Courtesy of Bilsom International, Inc.)

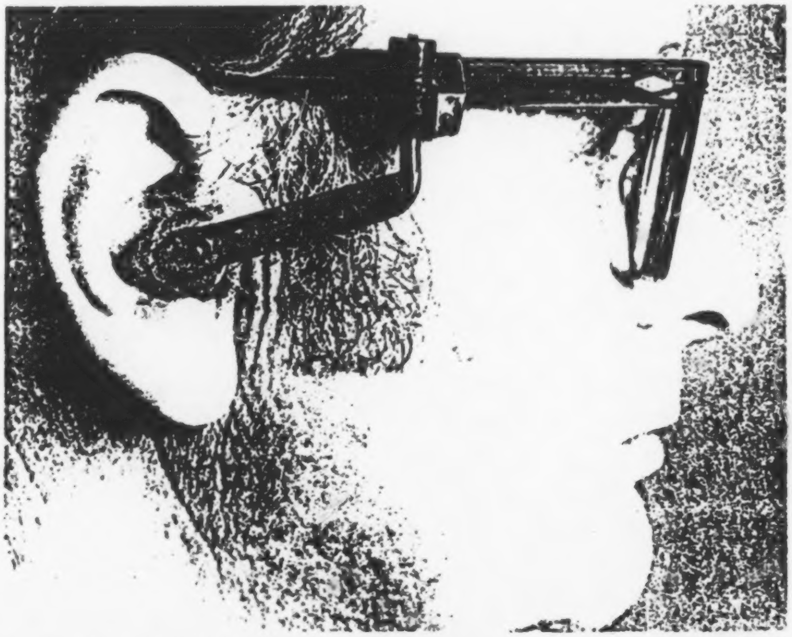


Designed for the individual requiring more than ear plugs, but not as much protection as ear muffs, these foam cushioned pods provide an acoustic seal at the entrance to the ear canal. The pods "blossom out" around the ear canal entrance, sealing the ear from harmful noises, without being inserted into the canal. The headband may be worn at various angles, and may be used with head protection. (Photo: Courtesy Willson Division, INCO Safety Products Co.)

- Material leaks;
- Hearing protective device vibration;
- Conduction through bone and tissue.

Seal leaks—Small air leaks in the seal between the hearing protector and the skin can significantly reduce the low-frequency attenuation or permit a greater proportion of the low-frequency sounds to pass through. As the air leak becomes larger, attenuation is less at all frequencies.

Material leaks—A second trans-



Adjustable in several directions, this type of hearing protector is mounted on the temple of spectacles, offering ready access when needed. The pod covers the ear canal to seal out noises. (Photo: Courtesy of Apex Safety Products.)

These light-weight hearing protectors may be worn in any of several positions. They need not be removed if face shields, glasses, welding hoods, or respirators are worn. The canal cap covers only the ear canal opening, does not enter the ear. The spring steel headband assures proper fitting. (Photo: Courtesy of H. E. Douglass Engineering Sales Co.)

mission pathway for sound is directly through the material of the hearing protective device. That is, the hearing protective device will attenuate or prevent the passage of most of the sound energy, but still allow some to pass through.

Device vibration—A third pathway for sound to be transmitted to the inner ear is when the hearing protective device itself is set into vibration in response to exposure to external sound energy. The amount of sound energy transmitted through the protector depends upon the materials of construction, design, and the mass of the device. It is possible, by adding more mass and more attenuating material, to obtain almost any desired degree of attenuation. The amount of attenuation attained is limited only by the cost and the massiveness of the protective device.

Bone conduction—If the ear canal were completely closed so that no sound entered the ear by this path, some sound energy still could reach the inner ear by means of bone conduction. However, the sound reaching the inner ear by such means would be about 50 dB less than the level of air-conducted sound through the open ear canal.

It is obvious, therefore, that no matter how the ear canal is blocked, the insert protective device will be bypassed by the bone-conduction pathway through the skull. A perfect hearing-protective device cannot provide more than 50 dB of effective sound attenuation.

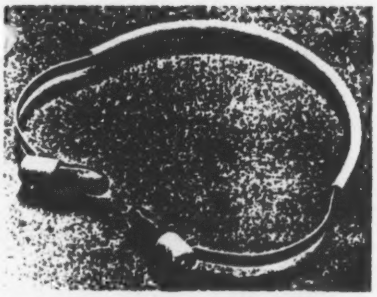
Hearing Protective Devices

Personal hearing protective equipment can be divided into four classifications:

- Enclosure (entire head);
- Aural insert;
- Superaural;
- Circumaural.

Enclosures

The enclosure-type hearing protective device, as the name implies, is incorporated in equipment that entirely envelops the head. A typical example is the helmet worn by an astronaut. In such instances, attenuation at the ear is achieved through the acoustical properties of the helmet.



Light-weight spring steel forms this headclamp, with replaceable ear plugs. The device may be worn over or in back of the head, or under the chin. (Photo: Courtesy of Marion Health and Safety, Inc.)

The maximum amount that a hearing protector can reduce the sound reaching the ear is about 35 dB at 250 Hz, and up to about 50 dB at the higher frequencies. By wearing hearing protectors, then adding a helmet that encloses the head, an additional 10 dB re-

The soft fibers of these disposable ear plugs provide comfort and effective attenuation of noise. To facilitate proper insertion into the ear, the material must be formed into a cone, then put into place while the ear is held back, slightly opening the ear canal. (Photo: Courtesy of Flents Products Co., Inc.)

These custom hearing protectors were molded from special silicone material mixed with a hardener, and rolled into a ball, which was shaped into a cone, and inserted into the ear canal where it set, conforming to the individual's ear canal and outer ear shape. (Photo: Adco Hearing Conservation, Inc.)

185

duction of transmission of sound to the ears can be achieved.

Helmets can be used to support earmuffs or earphones, and cover the bony portion of the head, in an attempt to reduce bone-conducted sound. They are particularly suited for use in extremely high-noise levels and where protection of the head is needed against bumps or missiles. With good design and careful fitting of the seal between the edges of the helmet and the skin of the face and neck, a further five to 10 dB of sound attenuation can be obtained in addition to that already provided by the earmuffs or earphones within the helmet. This approach to protection against excess noise is practical in very special applications.

Aural inserts

Aural insert hearing-protective devices are normally referred to as inserts or earplugs. This type is generally inexpensive, but the service life is limited, ranging from single-time use to several months.

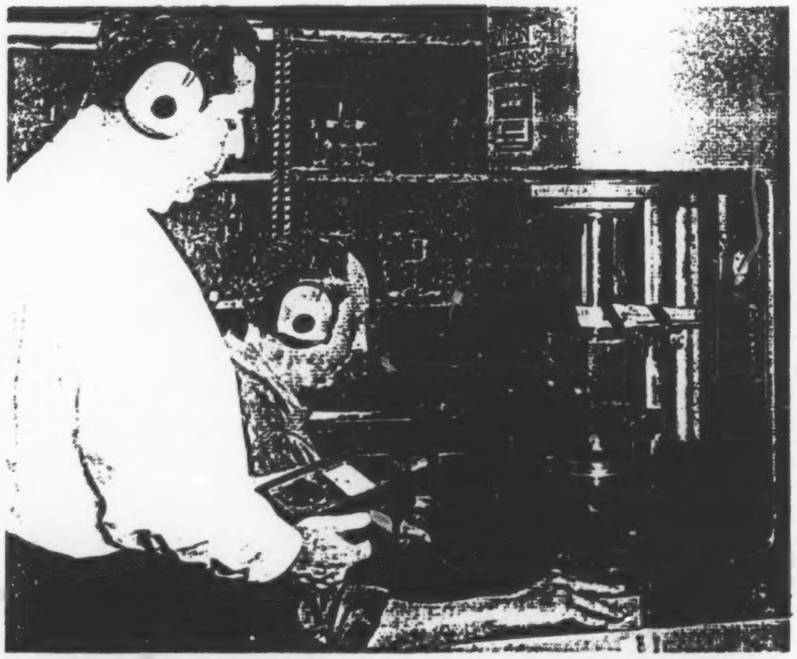
Insert-type protectors or plugs are supplied in many different configurations, and are made from such materials as rubber, plastics, fine glass down, and wax-impregnated cotton. The pliable materials used in these aural inserts are quite soft, and there is little danger of injury resulting from accidentally forcing the plug against the tender lining of the ear canal.

It is desirable to have the employee's ears examined by medical personnel before earplugs are fitted. Occasionally, the physical shape of the ear canal precludes the use of insert-type protectors. There is also the possibility that the ear canal may be filled with hardened wax. Where wax (cerumen) is the problem, it should be removed by qualified personnel.

In some cases, the skin of the ear canal may be sensitive to a particular earplug material, and it would be advisable to recommend earplugs that do not cause an allergic response.

Aural insert-type hearing protectors fall into three broad categories or general classifications:

- Formable type;
- Custom-molded type;
- Premolded type.



These light-weight hearing protectors may be worn over the head, behind the head, or under the chin, to afford protection during various working conditions, or with other types of personal protective equipment. (Photo: Courtesy of Pulmosan Safety Equipment Corp.)

These muffs offer hearing protection while the wireless communications system permits reception of instructions, emergency announcements, or background music. The units meet OSHAct requirements. (Photo: Courtesy of Earmark, Inc.)

Formable protectors—Formable types of hearing protective devices can provide good attenuation and fit all ears. Many of the formable types are designed for a one-time use only and then thrown away. Materials from which these disposable plugs are made include very fine glass fiber (quite often referred to as Swedish wool) wax-impregnated cotton, and expandable plastic.

These materials generally are rolled into a conical shape before being inserted into the ear. However, adequate instruction must be given to emphasize the importance of a snug fit, while at the same time a certain amount of caution also must be given not to push the material into the ear canal so far that it has to be removed by medical personnel.

Another type of material is a plastic-like substance which is similar in consistency to putty. The preparation of this material requires that the individual take a quantity of it and mold or form it so that it can be inserted into the ear canal. Users should be instructed so that they know the correct method of forming the material.

In addition, users must be cautioned to have clean hands when forming the material and placing it in their ears. If the hands are

In a high-noise industry, such as logging, these versatile hearing protectors may be worn in any of several positions, with the adjustable headband and the wide foam-filled ear seals offering comfort. Their low profile permits their being worn under a safety hat. (Photo: Courtesy of David Clark Co., Inc.)

dirty, foreign material can get into the ear canal.

Custom-molded protectors—Formable hearing-protective devices in this category are, as the name implies, custom-molded for the individual user. Generally, in this type, two or more materials (packaged separately) are mixed together to form a compound that when set resembles soft rubber. For use as a hearing-protective device, the mixture is carefully placed into the outer ear with some portion of it in the ear canal, in the manner prescribed by the manufacturer. As the material sets, it takes the shape of the individual ear and external ear canal. In some cases, the materials are premixed and come in a tube, from which they can be injected into the ear.

Premolded aural insert protector—Premolded-type insert protectors quite often are referred to as prefabricated, because they usually are made in large quantities in a multiple-cavity mold. The materials of construction range from soft silicone or rubber to other plastics.

There are two versions of the premolded insert protector. One is known as the universal fit type, in which the plug is designed to fit a wide variety of ear canal shapes and sizes. The other type of premolded protector is supplied in several different sizes to assure a good fit.

The design of the plug is important. For example, the smooth bullet-shaped plug is very comfortable and provides adequate attenuation in straight ear canals; however, its performance falls off sharply in many irregularly shaped canals.

The use of premolded insert-type protectors requires proper fitting by trained personnel. In many instances, the right and left ear canals of a given individual are not the same size or configuration. For this reason, trained personnel must prescribe the correct protector size for each ear canal. Sizing devices are available to aid in the proper fitting.

The premolded type of earplug has some disadvantages. In order to be effective, it has to fit snugly and, for some users, this is uncomfortable. Quite often, because the plug must fit tightly and because of the irregular shape of the ear canals that many persons may have, an incorrect size of plug is selected, or the plug is not inserted far enough, or a good fit cannot be obtained.

Some premolded type insert protectors may shrink and become hard, which is caused primarily by ear wax (present in all ear canals). The wax extracts the plasticizer from some plug materials, with a resultant hardening and possible shrinkage of the plug.

The degree of hardening and shrinkage of the plug varies from one individual to another depending on such things as temperature, duration of use, and personal hygiene of the user.

Regular cleaning of the protectors with mild soap and water prolongs their useful life. To keep the plugs clean and free from contamination most manufacturers provide a carrying case for storing them when not in use.

Superaural types

Hearing-protective devices in this category depend upon sealing the external opening of the ear canal to achieve sound attenuation.

A soft, rubberlike material is held in place by a very light band or head suspension. The tension of the band holds the superaural device against the external opening of the ear canal.

Circumaural protectors

Circumaural hearing-protective devices, usually called earmuffs,

This combination hearing protector and safety helmet provides two forms of personal protection. The light-weight muffs are designed for high noise environments, with foam ear cushions covered with plastic for added comfort. (Photo: Courtesy of Racal Airstream, Inc.)

High-attenuation hearing protectors are available for such areas as airports. This model features a swivel socket for universal positioning. Each cup can be independently adjusted to any head or ear contour. (Photo: Courtesy of Glendale Optical Company, Inc.)

High noise environments where this combination hearing protection device and communications system may be used include saw mills, airports, and rifle ranges. This model is equipped with a noise cancelling microphone to permit two-way conversations, in such instances as a pilot conversing with the ground crew. (Photo: Courtesy of Telex Communications, Inc.)

consist essentially of two cup- or dome-shaped devices that fit over the entire external ear, including the lobe, and seal against the side of the head with a suitable cushion or pad.

In general, the ear cups are made of a molded rigid plastic, and are lined with a cell-type foam material.

The size and shape of the ear cup vary from one manufacturer to another.

The cups usually are held in place by a spring-loaded suspension assembly or headband. The applied force is directly related to the degree of attenuation.

The width, circumference, and material of the earmuff cushion resting against the head must be considered to get a proper balance of performance and comfort. The width of the contact surface required to provide a good acoustical seal depends to a large degree upon the material used in the cushion.

The cup with the smallest possible circumference that will accommodate the largest ear lobes should be chosen. A slight pressure on the lobe can become painful in time, so it is very important to select a muff dome that is large enough.

The earmuffs currently on the market are supplied with replaceable ear seals or cushions that may be filled with foam, liquid, or air. The foam-filled type is the most prevalent. The outer covering of these seals is made of vinyl or a similar thermoplastic material.

Perspiration tends to extract the plasticizer from the seal material, which results in an eventual stiffening of the seals. For this reason, the seals require replacement at periodic intervals; the frequency of replacement is dependent upon the conditions of exposure.

Selection of Protector

The attenuation characteristics of a particular hearing protector must be considered before using it for a specific application (see accompanying graph).

As part of a well-planned hearing conservation program, characteristics of the noise levels for the various areas should be known. From these data and the attenuation information available from manufacturers, it can be determined whether a given device is suitable for the application intended.

Consideration must be given to the work area where the individual must use hearing protection.

For example, a large-volume earmuff would not be practical for an individual who must work in confined areas with very little head clearance. In such instances, a very small or flat earcup or insert-type protector would be more desirable.

When using muff-type protectors in special-hazard areas (such as power-generating stations where there are electrical hazards), it is desirable to use non-conductive suspension systems in connection with muff-type protectors.

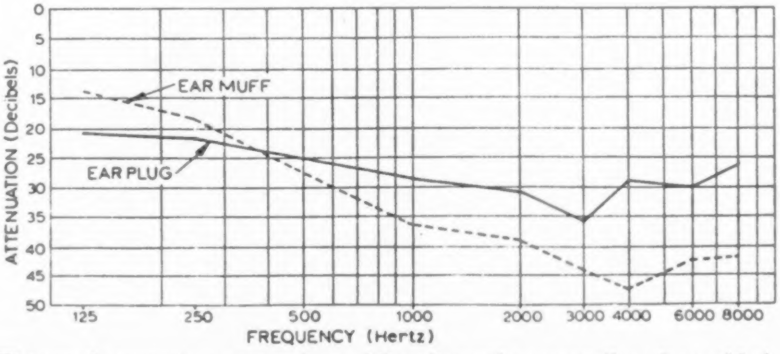
Also, if the wearing of other personal protective equipment, such as safety hats or safety spectacles, must be considered, the degree of hearing protection required must not be compromised.

When eye protection is required, it is recommended that cable-type temples be used. This type will give the smallest possible opening between the seal and the head.

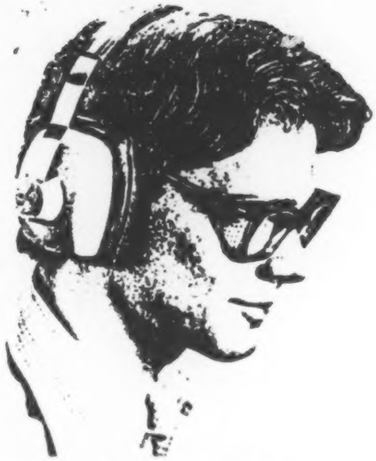
Other considerations when selecting a hearing-protective device include the frequency of exposure to excess noise (once a day, once a week, or very infrequently). For such cases, possibly an insert or plug device will satisfy the requirement. On the other hand, if the noise exposure is relatively frequent and the employee must wear the protective device for an extended period of time, the muff-type protector might be preferable.

If the noise exposures are intermittent, the muff-type protector is probably more desirable, because it is somewhat more difficult to remove and reinsert earplugs.

In determining the suitability of a hearing protective device for a given application, the manufacturer's reported test data must be examined carefully. It is necessary to correlate that information to the specific noise exposure involved. The attenuation characteristics of the individual hearing protective devices are compared at different frequencies.



The graph presents a comparison of the attenuation properties of a molded type earplug and an earmuff protector. Note that the earplug offers greater attenuation at the lower frequencies, while the earmuff is superior at the high frequencies. (From: **Fundamentals of Industrial Hygiene*****).***



Fully lined with polyester foam, these ear cups can be worn with either end up or either side forward. The hearing protectors meet Military Specification P-38268-B. (Photo: Courtesy of Jackson Products.)

Logging Industry Experience

Daniel B. Hartshorn, Safety Representative, State Compensation Insurance Fund, Stockton, CA, cites the problem experienced within the logging industry of some employees being reluctant to wear hearing protection while working daily with chain saws and heavy equipment, all generating high noise levels. Such employees, however, show no reluctance to wearing proper head protection, Hartshorn reports. "The answer may lie in the fact that a falling limb causes sudden injury, while hearing loss occurs over a long period of time, making the need for hearing protection less dramatic and less convincing than the need for a hard hat. Employees have it in the back of their minds that the payoff for wearing hearing protection is a long way down the road."

Hartshorn cites three reasons why such an attitude must be changed, through efforts on the part of management:

- It is the employer's legal responsibility to provide hearing protection when noise levels exceed established federal or state standards.

- Providing hearing protection is a moral responsibility. It's up to the employer to do what he can to prevent employees from sustaining injuries that are preventable. The tragedy of serious noise induced hearing loss is that it is typically permanent and non-correctable. The double tragedy is that this type of hearing loss continues to happen, even though it is easily preventable by the use of hearing protection.

- It is the employer's fiscal responsibility to reduce losses and costs wherever possible. Whether self-insured or insured with an insurance company, hearing loss claims ultimately end up costing the employer money. In 1976, the cost of hearing loss claims reached $73,462 for just those logging companies in California insured by the State Compensation Insurance Fund. The trend toward more claims and increased costs is expected to continue, especially if hearing conservation programs are not started by logging firms.

According to Hartshorn, a number of studies conducted by the State Compensation Insurance Fund in California have found that most logging occupations are in need of hearing protection. A recent study was performed by the State Fund in cooperation with a logging company in the Sonora area. Noise levels were measured with a calibrated sound level meter. The results of that sound level survey are presented in the accompanying table.

A noise dosimetry survey also was conducted at the same logging operation. The study involved employees wearing noise exposure monitors. Hartshorn explains that the dosimeters were worn by employees so that each person's total exposure to noise during the work day could be determined. The dosimeters electronically recorded the duration and magnitude of all sounds above 90 dBA. The information was then electronically summed by the dosimeters to give a reading that is a percentage of the exposure permitted under pertinent regulations. As an example of the readings obtained, one dozer-skinner was exposed to levels of noise that were 466 per cent more than the allowable limit.

An earlier study conducted by John Moody, a safety consultant and district safety manager of the Redding, CA office of the State Compensation Insurance Fund, also showed excessive noise exposure in woods operations. Percentages of experienced noise compared to allowable limits equalled 309 per cent for skidder operators, 403 per cent for knot bumpers, 349 per cent for tractor operators, and 853 per cent for fallers.

To combat such problems, Hartshorn stresses that engineering

Ear muffs and other forms of hearing protection should periodically be disassembled, if possible, cleaned according to the manufacturer's instructions, then reassembled and adjusted for the next user. (Photo: Courtesy of Mine Safety Appliances Company.)

controls should be the first line of attack on a noise problem. "In fact, regulations require that engineering and administrative controls be used first, whenever the operations reasonably permit. Whenever equipment is bought, specifications should be checked out to determine how much noise it produces. Certain makes and models of chain saws are quieter than others. Different dozers and front-end loaders are quieter than others. Some loaders have enclosed cabs, which greatly reduce noise exposure to the operator. Mufflers also are important in reducing noise levels, and should be used to their best advantage."

Hartshorn continues, "The second form of attack on a noise problem should be of an administrative nature. Whenever possible, employees exposed to high noise levels should be rotated to low noise jobs for part of their work day. This is not often practical in the woods, but some possibilities exist. If any workers at the landing are constantly using chain saws, while others are just marking logs and removing chokers, the chain saw job could be shared. Another possibility would be to rotate the choker-setters, who have relatively little noise exposure, with the landing men who have greater exposure."

The final line of attack on a noise exposure problem, Hartshorn explains, is through personal protection devices—ear muffs and ear plugs. "Although engineering and administrative controls may help reduce noise exposure in many cases, some form of personal hearing protection is probably going to be needed in many woods situations," he states.

Sonora, CA, Logging Area Sound Level Survey Conducted by State Compensation Insurance Fund

Type of Work	Sound Level (dBA)	Approximate Length of Exposure	Cal/OSHA Allowable Exposure	Hearing Protection Needed
Falling/bucking:*				
Chain saw cutting	103 to 110	At least three hours	One hour at 105 dBA	Yes
Dozer-skinning:**				
Tractor under load	100	At least four hours	Two hours at 100 dBA	Yes
Loading trucks:***				
Front-end loader under load	101	At least four hours	Two hours at 100 dBA	Yes
Bumping knots:*				
Chain saw cutting	98 to 105	At least two hours	90 minutes at 102 dBA	Yes
Setting chokers:				
Four to 12 feet from tractor	80 to 90	Less than eight hours	Eight hours	No

*Saws: Stihl 045, ER Homelite 650
**Caterpillar D8H tractor
***Caterpillar 977H.

Flexible attachments from the cup to the headband assure proper fitting of these ear muffs, during continuous wearing throughout the work period. (Photo: Courtesy of Zee Medical Products Co., Inc.)

To establish an effective program of personal hearing protection, Hartshorn advises the following procedures:

- Identify those employees who need to wear hearing protection.
- Establish a written company policy requiring the use of hearing protection by those identified as having such a need.
- Stand behind and enforce the established company policy. All supervisory personnel should wear hearing protection in areas that have been identified as "high noise," to set the needed example.
- Employees must be made aware of the immediate health advantages that can be achieved by the use of hearing protection. Excessive noise can cause nausea, fatigue, headaches, temporary hearing loss, and ringing in the ears.

Hartshorn states, "Hearing protectors that fit into the ear itself are not recommended for use in the woods. The opinion of the State Fund's industrial hygiene staff is that the hot and dirty conditions experienced in the woods could cause the plugs to become contaminated if often removed and reinserted during the day. Because this type of hearing protector actually fits inside the ear canal, it could cause an ear infection if it became contaminated. Another problem is that this type of hearing protector is not as easy to remove and properly replace as the ear muff designed to be attached to the hard hat."

Hartshorn concludes, "Such a program will, of course, cost money. But it can be far less than the increase in costs that can be caused by hearing loss claims. In the final analysis, a hearing conservation program, which is supported and enforced by management and is accepted by the employees, will be a valuable addition to an industry and to the health and well-being of its employees." Ω

By Edward D. Dionne,
Associate Editor, NSNews

Head Protection Is on Top of Worker Safety

If the correct hard hat is selected for an employee, it can be integrated with other types of personal protection.

SAFETY HATS AND CAPS protect against the everyday hazards of bumping one's head or having it struck, of contacting high voltage equipment, or of having materials fall on the head.

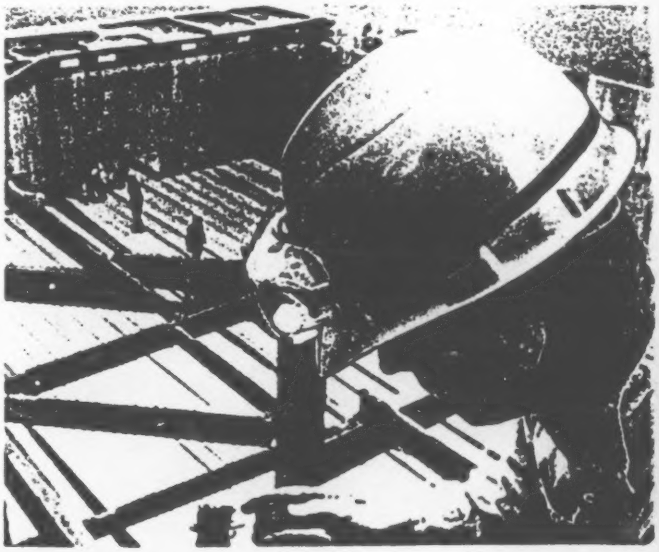
Hats help prevent serious injuries in many ways:

- They cushion impact four ways—The hard shell resists and deflects a blow, impact is distributed over a large area, the hat suspension acts as a shock absorber, and even if the hat does dent or shatter, it still takes force out of the blow;
- In addition to having impact-resistance, safety hats for electrical workers should meet test requirements for dielectric strength and imperviousness to moisture in order to protect against electric shock[1];
- Finally, safety hats often can save the scalp, face, and neck from overhead spills of acids or hot liquids, and help prevent collection of irritating chemical dusts in the hair.

The protecting ability of a safety hat depends importantly on the shock-absorbing space maintained between the hard shell and the head by the suspension.

This space must not be interfered with, or the hat's ability to resist breaking and prevent injury will be reduced. Therefore, safety hats should never be worn on top of everyday hats or parkas, particularly if the suspensions have to be removed. Special winter liners can be obtained.

OSHA requires the use of industrial safety helmets that comply with American National Standards Z87.1-1969, *Practice for Occupational and Educational Eye and Face* Protection; Z89.1-1969, *Safety Requirements for Industrial Head Protection;* and Z89.2-1971, *Safety*



The accessory mount on this hat increases its use for a multiplicity of work situations. (Photo: Courtesy Glendale Optical Co., Inc.)

A non-conductive safety cap protects this worker in a liquefied gas plant. Added protection is offered through the safety glasses and the nonconductive hearing protectors, plus the available all-plastic soft-sided splash goggles. (Photo: Courtesy of Jackson Products).

Requirements for Industrial Protective Helmets for Electrical Workers, Class B.

In recent years NIOSH has conducted studies that have indicated that some models of industrial safety helmets did not perform at levels in compliance with the standards.

Accordingly, NIOSH has proposed a certification program for such helmets. Although the performance requirements are those of the ANSI standards, at least one important change in the method of testing has been made. The mechanical impact force measuring device specified in the standard has been replaced by an electronic system. The system should minimize interlaboratory variances, NIOSH believes. The electronic system has been developed through the cooperative efforts of NIOSH and U.S. helmet manufacturers, and it is expected to be incorporated into any revisions of the American National Standards.

Definitions

Safety hat (or *cap*) is the name suggested to replace the less accurate "hard hat" or "helmet." Components of safety hats are:

Hat, Cap—A rigid device worn to provide protection to the head, and held in place by suitable suspension;

Shell—A hat or cap, without the suspension, accessories, or fittings;

Brim—An integral part of the shell extending outward from the entire circumference, which protects the face, neck and shoulders;

Peak—An integral part of the shell extending over the eyes only;

Suspension—The internal cradle of the hat or cap, made up of sweatband and crown straps;

Crown Straps—That part of the suspension that passes over the head;

Sweatband—That part of the suspension that encircles the head;

Chin Strap—An adjustable strap attached directly or indirectly to the shell, which fits under the chin to secure the hat or cap to the head;

Nape Strap—An adjustable strap attached directly or indirectly to the shell, and fitting behind the head to secure the hat or cap to the head;

Winter Liner—A snug-fitting cover worn under the hat or cap to protect the head, ears, and neck from the cold.

Hat Styles

There are two basic styles: a safety hat with a brim completely around the hat, and a safety cap or visor-type safety hat with a peak in front.

When the wearer works in cramped quarters, the full-brimmed hat may catch or be bumped, causing it to tilt on the head. In this case, a visor-type cap might be considered.

Still a third type of head protection device is the *bump cap*, a brimless and suspension-less device designed to fit closely to the skull, and only in tight working areas. It serves *only to protect the wearer from bumping into protruding obstructions*, such as a mechanic encounters when working under an auto.

Safety hats (or caps) can be modified for many uses. Some models have brackets to support welding helmets, visors, goggles, ear muffs, or lamp brackets to support miners' cap lamps. Some have plastic eye shields, hinged under the peaks to lie flat when not in use. Face shields, made in varying thicknesses of clear or tinted plastic or of wire mesh screen, are attached by various means. Some safety hats are equipped with ear muffs to provide hearing protection.

All styles have provisions for chin straps, nape straps, or both, which will keep them from being knocked or blown off.

Safety hat manufacturers supply several types of suspensions that cannot be adjusted to result in an unsafe crown clearance. The first of these has a non-adjustable set of cradle straps, giving a preset crown clearance. The other has two sets of cradle straps: one is fixed, but the second is adjustable for the comfort of the wearer. Sweatbands in these suspensions are made of leather or synthetic materials and are adjustable to fit all head sizes.

The entire suspension should be replaceable. It should be changed when it begins to deteriorate, or when a hat is transferred from one person to another.

Winter liners should be made either of water-resistant cloth with fleece or wool lining or of knitted wool. They can be obtained with or without ear-flaps.

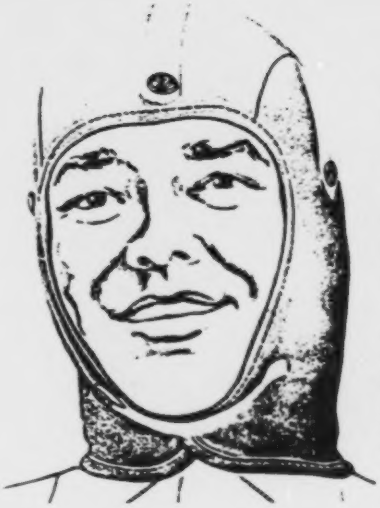
The winter liners should not be made of flammable material.

The shell usually is attached to the liner by crown straps or snaps, to keep the hat from slipping or falling off and to assure full head protection.

Shell Materials

Safety hats and caps may be made of the following materials:

- Laminated phenolic resin—Molded under high pressure, this material provides excellent resistance to impact and penetration of falling objects, has dielectric strength, and is not affected by water, oil, and most acids.



Adjustable straps on the top and sides of this liner permit it to be affixed inside any style safety hat or cap. The long length protects the wearer's neck area in cold weather, eliminates any need for a possibly hazardous scarf. (Photo: Courtesy of W. M. Bashlin Co.)

- Thermoplastics—Molded at high pressure, these are resistant to impact and penetration of falling objects, and are not affected by water, oil, and most acids. In addition, thermoplastic shells have exceptionally good dielectric strength.

- Glass fiber impregnated with polyester resin—Pressure-molded, this shell provides excellent resistance to impact and penetration of falling objects, has dielectric strength, and is not affected by water, oil, and most acids.

- Aluminum—Special alloy shells are resistant to

This fireman's helmet is made of high pressure injection molded polycarbonate with non-conduction of electric current capabilities equal to the dielectric strength specified for electric utility workers' helmets. The broad rim helps deflect falling objects.

This cap, designed especially for use in the mining industry, has a low crown for work in low-ceiling areas. It is equipped with a lamp bracket and cord holder to support a miner's lamp. (Photos: Courtesy of Mine Safety Appliances Company.)

This Class A hard hat is designed to meet test requirements specified in ANSI Standard Z89.1-1969, including insulation-resistance testing to 2,200 volts for one minute with less than three milliamps leakage. (Photo: Courtesy of E. D. Bullard Company.)

impact and moisture, but, because they conduct electricity, they should not be worn where there is danger of electrical contact.

Hats (or caps) containing phosphorescent pigments that glow in the dark are obtainable for use in tunnel work, mining, and night construction operations.

Light-reflecting tape may be placed on the back and sides of safety hats for outdoor workers. In this way they may be spotted quickly at night, if light strikes them.

Companies who wish to designate the wearer's department or trade by color-coding should *not* paint the hats. Instead, the hats should be purchased in the colors desired.

Care of Safety Hats

Because safety hats (or caps) can be damaged, they should not be abused. They should be kept free from abrasions, scrapes, and nicks, and they should not be dropped, thrown, or used as supports. This applies especially to hats that are intended to afford protection against electrical hazards. When such hats are carried in a truck, a special rack should be constructed to hold them securely, so that they will not become damaged or have their dielectric strength impaired.

If safety hats are to be initialed or marked in some way to prevent random exchange among workers, care should be taken that the marking does not, in any way, affect the dielectric strength of the hat.

Workers should be instructed to wipe dust or moisture from their hats before storing them.

A schedule should be established and maintained for the periodic inspection of all safety hats. Electrical safety hats should be inspected visually each day for defects, such as cracks, pit marks, or other abrasions that have occurred through use. It is recommended that management arrange for periodic electrical tests of such hats. In addition to giving the worker confidence that his equipment still meets safety specifications, this procedure gives management a double-check on irregularities.

Hats worn by electrical workers and used primarily for electrical protection must be destroyed when they are found to contain cracks, abrasions, or other physical damage, or when they fail to pass an electrical proof test.

A replacement system should be set up, so that the worker can turn in his hat if he finds it damaged or in need of a new suspension or sweatband. Hats turned in with sound shells may be transferred to other employees, if the shell is thoroughly cleaned, sanitized, and supplied with a new suspension.

Tars, paints, oils, and adherent dirt should be removed with non-flammable and non-toxic solvents. Because some solvents can be harmful to dielectric hats, the hat manufacturer should be queried before choosing a solvent.

A common method of cleansing the shells is to dip them into a tank of hot water, not in excess of 140 F

Strong winds fail to dislodge these light-weight safety caps, available in six colors for quick identification of department personnel. The six-point suspension and a double-locking headband adjustment permit comfortable wearing. They meet ANSI standard Z89.1-1969 specifications for Class A and Z89.2-1971 for Class B applications. (Photo: Courtesy of Sellstrom Mfg. Co.)

(60 C) and containing a detergent, for at least one minute. These hats then should be scrubbed and rinsed in clear, hot water with a maximum temperature 140 F. (Hats should be dipped using a wire basket to prevent hand and arm burns.) After rinsing, hats should be wiped dry and inspected for damage. New suspensions should be installed and the entire unit placed in a plastic or paper bag or box to protect it against dust and handling damage.

This program of cleanliness is appealing and gives direct evidence of interest in the employees' welfare. It can play an important part in gaining the full cooperation of employees in other safe practices.

Starting a Program

Companies engaged in operations involving hazards to the head (blows, spills, or electric shock) should provide for head protection of all people involved, according to *OSHAct.* Examples of such operations are: construction work, tree trimming, shipbuilding, logging, mining, overhead line construction or maintenance, and basic metal (steel, aluminum) or chemical production.

Safety professionals should be aware of changes in operations that may create a need for head protection. For example, a plant undergoing a slack season might transfer certain employees from relatively safe jobs to functions requiring safety hats (or caps). In addition, construction, maintenance, and odd jobs requiring head protection often occur during normal operations.

To control the head injury hazard, a safety specialist should review the types of accidents and near-accidents that have occurred to discover any need for protection.

Where hazards exist, the safety specialist should personally watch operations, talk to workers in charge, and observe unsafe practices or conditions.

Taking the assembled information, a safety specialist should meet with top management to establish policy governing head protection.

This policy should regulate the purchase of safety hats (or caps), designate wearers, and propose methods of enforcement. Management then can instruct supervisors and workers about hazards and precautions.

Supervisors should set an example by wearing a safety hat at all times. They also should answer questions, review complaints, and sell the correct use of the hat by daily association and demonstration.

One way to inaugurate or improve a safety hat program is to discuss head injury hazards, accident experience, and the merits of various hat programs at a supervisors' meeting.

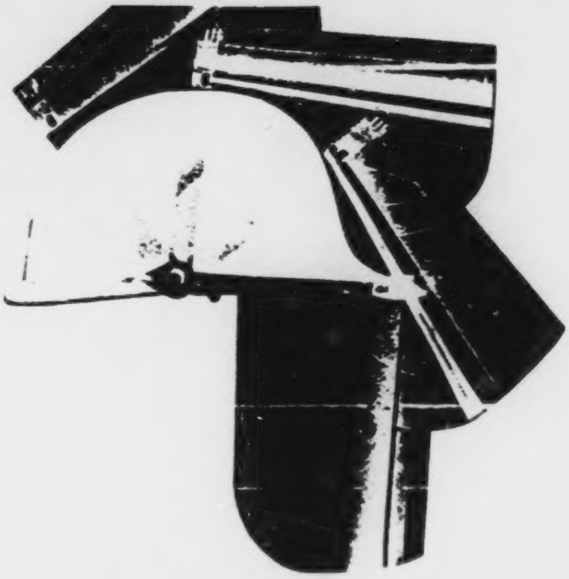
Top management should participate in the meeting to emphasize the importance of the program. At this meeting, a safety specialist should display several samples of safety hats. He should be ready to discuss styles, materials, attachments, availability of parts, and general service and delivery.

After a program is started, there are a number of methods for issuing safety hats. If state laws or

This close-fitting, seven-ounce bump cap offers protection for those who work in cramped quarters or areas with low head clearance. The four-point suspension system features a foam padded vinyl headband attached by snap-tab locks. Vent holes on each side add comfort. (Photo: Courtesy Apex Safety Products.)

This specially designed winter liner for hard hats and caps fits snugly around the underside of the brim to prevent wind from tunneling and circulating inside the crown. It is made of DuPont's flame-retardant nylon, which also is washable. (Photo: Courtesy of American Allsafe Co., Inc.)

p backward of the wearer's head permits this shield to be raised, and a quick nod makes it descend. Special ting hardware permits affixing face shields for welders rotective equipment for other workers. (Photo: Courtesy of Norton Company, Safety Products Division.)



Act require head protection in certain types of hats or caps for these employees should be fur-d without cost. Even aside from this, the usual today is to issue hats or caps without charge, h tool checks. Some companies may require a leposit to encourage reasonable care and return hat at the end of a job. Some companies charge ll price or suggest that workers purchase their ead protection. However the hat is issued, part procedure should be to have a talk with the yees on its construction, how to handle it, and ow much protection it affords.

oting the program

e companies put an employee's initials or name front or side of the hat, either by hand or with d of decals, stencils, or self-adhesive tape. (When done, care should be taken to make certain othing is done that will affect the strength of t).

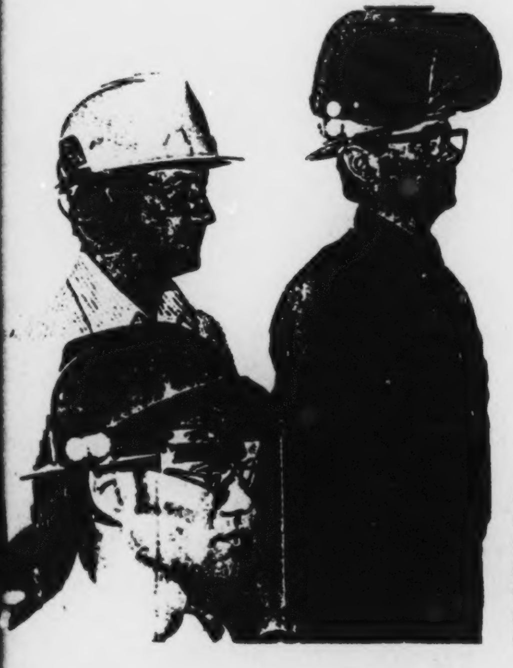
quently, the workers are requested to take their hats home with them and inform their families the program.

ty hats *never* should be stored on the rear win-helf of an auto. Intense sunlight and heat may some types to deteriorate. In case of a sudden he safety hat may be projected against the back of a driver or his passengers.

When promotion is needed, photographs and stories can be placed on bulletin boards, in the company's publications, and in local newspapers. Pictures of personnel on the job wearing safety hats (or caps) can show that such protection does not interfere with movement. A safety professional should ask individual workers wearing the hats to contribute comments for this promotion. In stories, the head injury hazard and the safety hat program can be explained. This publicity also acquaints the public with the company's interest in employees'-welfare.

The first head injury prevented by a safety hat should be given wide publicity. It is a good practice to have photographs taken of the worker, a member of the safety committee, and other company officials. The story of the accident, along with the photos, may be placed on company bulletin boards, sent to local newspapers, and used in company publications. At all times, the hat or cap that saved a person's life should be displayed.

Safety meetings should be held with supervisors and employees on the job to promote the program. During these meetings, a safety specialist and other members of management can explain why it is important for all personnel to wear head protection. Insurance company safety consultants can be called upon to give talks, relate experiences, and use training aids to sell the importance of safety hats. (Sometimes these outside sources can have more effect upon employees



Illustrated are three types of special personal protective equipment that can be attached to this hat. They include a face shield, hearing protection, and a welding helmet. The cap is equipped with a special device that eliminates any need to drill holes or otherwise modify the hat for different attachments. (Photo: Courtesy of United States Safety Service Co.).

than the services and experiences of their own safety director.) Complaints about safety hats can be forwarded and answered, demonstrations made, and educational materials issued during meetings.

Handling complaints

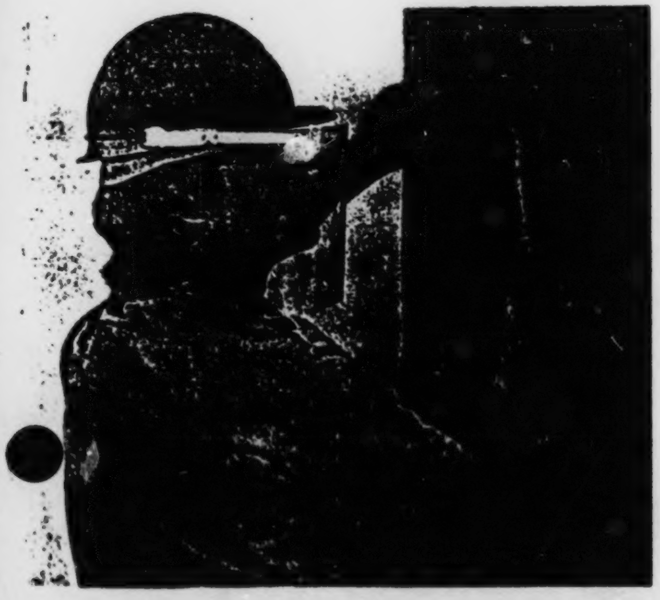
A typical complaint concerns improper fit, which causes headaches or causes the hat or cap to move loosely and fall off. The wearer should be instructed how to adjust the sweatband for the individual's head size. Different adjustments can be made according to the size markings on the sweatband. With proper band size, the hat will stay on while an employee is bending over, yet will not be so tight that the band makes a mark on one's forehead.

In addition, crown straps have a tie cord to adjust for a shallow or deep cranium. The wearer should always make certain that there is one- to one-and-one-fourth-inch (2.5- to 3.2-centimeter) clearance between the top of the wearer's head and the inside shell of the hat, because of its importance to protection, especially where hats do not have secondary straps preset at the proper clearance.

Other criticisms are that the hats are too hot, too cold, or too heavy. The weight argument can be dismissed because the actual weight of safety hats or caps is within ounces of the weight of an ordinary felt hat. For summer wear, safety hats are cooler than everyday headwear: they reflect heat as well as or better than ordinary hats, and they have an open space between the wearer's head and the crown of the hat that allows free air circulation. They are colder in the winter, however, because of this space and air circulation, unless a winter liner is used.

Some hair styles will not permit the proper wearing of a safety hat, and, as a result, the employee may remove the suspension to make the hat fit. The company should not allow this, and should make sure that employees understand such danger. Ω

This helmet, by Racal Airstream, Inc., offers a hard hat, face visor, and air filter designed to provide a continuous stream of fresh, cool air over the user's face, automatically removing dust in various work environments. The power pack is worn at the belt. (Photo: Courtesy of Direct Safety Company).



Safety glasses worn in addition to the face shield affixed to this safety hat assure eye protection. (Photo: Courtesy Pulmosan Safety Equipment Co.).

REFERENCES

1. *Safety Requirements for Industrial Protective Helmets for Electrical Workers, Class B, American National Standard Z89.2-1971.* American National Standards Institute, 1430 Broadway, New York, 10018.

BIBLIOGRAPHY

Safety Requirements for Industrial Head Protection, American National Standard Z89.1-1969. American National Standards Institute, 1430 Broadway, New York, 10018.

Specifications for Protective Headgear for Vehicular Users, American National Standard Z90.1-1971. American National Standards Institute, 1430 Broadway, New York, 10018.

Specifications for Electrical Workers' Insulating Headgear, AP-1-1961. Edison Electrical Institute, 90 Park Ave., New York, 10016.

"Personal Protective Equipment," Chapter 19, *Accident Prevention Manual for Industrial Operations* (Seventh Edition) 1974. National Safety Council, 444 N. Michigan Ave., Chicago 60611, pp. 469-476.

New Dimensions in Foot Protection

By Frederick A. Meister, Jr., *President and Chief Executive Officer, American Footwear Industries Association, Washington, DC*

PROPER FOOT PROTECTION is essential for the safety of employees in the industrial workplace, and any safety program truly must start "from the ground up."

Although safety footwear is well recognized as an effective means to provide necessary foot protection, hundreds of thousands of foot and toe injuries continue to occur on the job site every year. This is due largely to the fact that many employees do not wear safety footwear when the potential for foot injuries exists.

EDITOR'S NOTE: This article pertains especially to safety shoes and non-rubber footwear. A future NSNEWS article will cover recent advances in the natural rubber and synthetics footwear industries.

A two-year study conducted by the Eastman Kodak Company revealed that in 81 per cent of all documented injuries to the toe, safety shoes were not being worn.

A recent survey by the Department of Labor's Bureau of Labor Statistics (BLS) revealed that less than one-fourth of all employees were wearing safety shoes at the time of an accident involving foot injuries.

Eastman Kodak's study further revealed that 86 per cent of those foot injuries studied could have been prevented through the use of safety footwear. Clearly, an increased use of safety footwear could result in a dramatic decrease in foot injuries in the workplace.

The American footwear industry is working diligently to encourage the wearing of safety footwear by offering great comfort, an increased variety of styles, and provisions for greater protection to those employees who choose to wear such protective apparel. Such efforts by this industry will increase the effectiveness of safety footwear in preventing injuries, ensure that such items meet high quality standards of workmanship, and reduce employee reluctance to wear appropriate safety footwear.

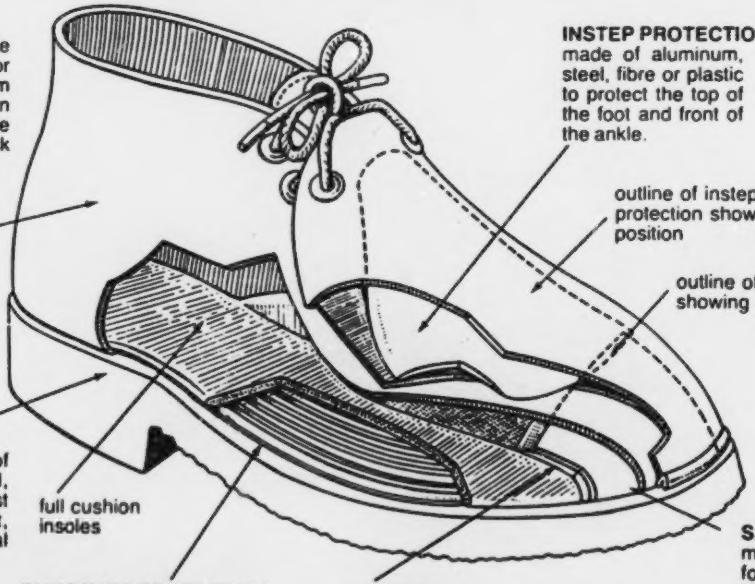
Types of Footwear

Four commonly used types of safety footwear are:

- Safety-toe footwear;
- Metatarsal safety-toe footwear;
- Conductive safety-toe footwear;
- Electrical hazard safety-toe footwear.

Of these four types, men's and

ANATOMY OF A SAFETY SHOE



SPECIAL ANKLE PROTECTION (not shown) is available to prevent small sparks or burning particles from getting inside shoe. An elastic gore is available instead of laces for quick removal of shoe.

INSULATED against heat and cold—also may be waterproof and chemical resistant.

SPECIAL MATERIALS soles may be made of leather, rubber, cord, wood, to protect against slipperiness, oil, heat, chemicals, or electrical hazards.

full cushion insoles

PUNCTURE PROTECTION with spring steel insole. Sometimes includes protective lip around arch area.

CUSHION between toe cap and foot for comfort and insulation.

INSTEP PROTECTION made of aluminum, steel, fibre or plastic to protect the top of the foot and front of the ankle.

outline of instep protection showing position

outline of toe cap showing position

SAFETY TOE must meet standards for impact (objects falling on toe) and for compression (weight pressing on toe).

Exhibited here is a unique forepart lasting process for the safety shoe, permanently locking the steel toe cap in place. The wide flange toe box provides a significant increase in bearing surface, thus offering greater protection that exceeds the highest ANSI classifications for such shoes. (Photo: Courtesy of Knapp Shoes.)

women's safety-toe footwear is by far the most commonly used. Safety-toe footwear is designed to prevent or reduce the severity of injury to the toe portion of the foot. The construction of safety-toe footwear is largely the same as that of any shoe, except that a steel toe box is added for additional protection.

Metatarsal safety-toe footwear protects both the toes and the metatarsal area of the foot. Additional protection is provided for the metatarsal area by placing a metal guard over that part of the foot.

Conductive footwear serves two purposes. One such type provides protection against the build-up of static electricity; such footwear is extremely useful in areas where there is a threat of explosion, or where explosive mixtures are present. A second type of conductive footwear is used by linemen and other workers who are exposed to high voltage lines. This footwear is designed to equalize the potential of the worker and the energized lines to which he is exposed.

The fourth type of commonly used safety footwear is electrical hazard safety-toe footwear, designed to provide protection against open circuits of up to 600 volts.

It is the toe box or the steel toe piece that is common to each of these four classifications of safety footwear. Efforts to improve the effectiveness of safety footwear centers on improving the effectiveness of the toe box.

Wide Flange Factor

Many footwear manufacturers are now employing toe boxes with a wide flange or lip, that increases the surface area between the toe box and the inner sole. In the past, the full protective potential of some safety-toe footwear was reduced because of the use of a narrow flange lacking the new lip. The narrow lip afforded little surface area between the inner sole and the toe box. Thus, when subjected to extreme impact or compression, the safety-toe could cut through the sole. This resulted in a situation in which the toe box itself may have withstood the pressure of impact or compression, but the clearance between the toe box and the toe itself was sharply reduced because the toe box was jammed into the sole.

The new wide flange helps to eliminate this problem. Even when subjected to extreme amounts of pressure, the new wide flange will not cut through the sole, because of the greater surface area now present, providing the necessary clearance to avoid injury to the toe.

Increased Sole Strength

Another recent development is the use of new sole constructions and sole materials to increase the strength of the sole itself. This helps to eliminate the possibility of the toe box cutting through the sole. These new construction designs and materials increase the resistance of the sole to the impact of the toe box, affording greater degrees of protective clearance.

Footgear using this new type of construction has been able to exceed the toughest safety footwear standards by great margins, offering protection not previously available.

Performance Standards

Not only is the footwear industry undertaking developments to improve the effectiveness of safety-toe shoes, but steps also are being taken to ensure that certain performance standards consistently are being met.

Although the federal government has set no *mandatory* standard for safety footwear, a committee of footwear manufacturers, retailers, employers, employees using safety footwear, government officials, and technical specialists has set precise performance standards for men's metatarsal, conductive, and electrical hazard safety-toe footwear under the aegis of the American National Standards Institute (ANSI). This is commonly known as the Z-41 standard.

A new standard for women's safety-toe footwear is forthcoming.

The Z-41 committee has established three classes for the footwear, based upon the amount of protection afforded. These classifications are 75, 50, and 30, with Class 75 giving the greatest degree of protection. The accompanying table indicates the *minimum* protection that must be afforded for each class.

Each of the four types of safety-toe footwear—men's, metatarsal, conductive, and electrical hazard—must meet the requirements set forth in the table. Additional standards also have been set for metatarsal, conductive, and electrical hazard footwear.

Although safety-toe footwear can be marketed in the U.S. without meeting these standards, *OSHAct* regulations require that safety-toe footwear meeting the ANSI standards must be used when safety-toe footwear is required by federal regulations.

AFIA Certification

As a service to consumers of safety-toe footwear, the American Footwear Industries Association administers a certification program that ensures the consumer that the precise ANSI performance standards have been met. Each certified style of footwear is tested by an independent testing laboratory to ensure that these strict standards have been met. The shoes then can be labeled so that the consumer knows that his footwear indeed meets these standards.

AFIA's certification program also enables large-volume buyers of safety footwear to eliminate their own testing programs.

In addition to testing each style for performance, the independent testing laboratory also inspects each footwear manufacturing plant prior to granting certification, and ensures that proper quality control techniques are employed. Follow-up inspections occur twice each year, to ensure that workmanship remains at a first class level, and that selected styles continue to meet the ANSI standard.

Promoting Safety

Despite the well-known effectiveness of safety-toe footwear in reducing foot injuries, and the efforts being undertaken by the footwear industry to ensure that its safety footwear continues to meet the highest standards of quality, some workers are still reluctant to use safety footwear in areas where hazards exist.

Commonly heard complaints are: "They don't make safety-toe shoes for women"; "I don't have the money for another pair of shoes"; "it's too ugly—I'm going to wear my street shoes, instead"; and, "safety footwear is too heavy; it only makes me tired."

The domestic footwear industry and employers have taken numerous steps that have made all of these statements invalid.

As the number of women in the work place increased during the past decade, so has the availability of women's safety footwear. A larger number of footwear manufacturers now make women's safety-toe footwear in all styles and sizes. No longer should women feel that their only two options are to wear men's safety toe footwear, or to go without needed foot protection.

Plant Programs

Employers have initiated a number of innovative safety programs that enable their employees to secure safety footwear without incurring great cost. Many employers now provide employees with their first pair of safety shoes, and then require employees only to purchase replacement footwear.

Other employers give their employees an allowance to be applied toward the purchase of safety footwear. An advantage of this program is that it permits employees to purchase those styles of safety footwear with which they feel the most comfortable. If an employee desires to purchase a pair of safety Western boots, for instance, that are more expensive than standard safety-toe shoes, the employee can pay the difference and purchase a pair of safety boots with which he or she is more pleased.

Other firms purchase one pair of safety shoes annually for each of their employees, so that the employees incur absolutely no cost for safety footwear whatever.

Some employers participate in shoemobile programs, which bring safety shoes and professional fitters to the plant, thus giving employees the convenience of buying the footwear at the plant, and also the satisfaction of getting the professional fit.

New Styling

No longer should style considerations have any bearing on an employee's refusal to wear safety footwear. Many footwear styles now have a safety-toe counterpart. In fact, one major manufacturer produces more than 100 styles of safety-toe footwear. Now, not only can the consumer buy the traditional work boot with a safety-toe, but safety-toe dress oxfords are available for executives who must spend part of their day in the plant and part outside the office.

Safety-toe athletic shoes, which afford just as much protection as other types of safety-toe footwear, are available for those workers who prefer the casual look. Western boots or cowboy boots also are available in safety-toe styles.

There is safety footwear for almost any occupation. The dress oxford is available for the executive; insulated work boots are available for people working outdoors or in cold storage facilities; leather boots rising almost to the knee are available for those who must climb in their jobs. Safety footwear also comes in chemical-resistant and waterproof varieties.

Less Weight

Safety footwear also has lost weight during the past few years—and the trend continues. Work is being undertaken to develop fiberglass or plastic toe boxes that offer the same degree of protection as the standard steel toe box, yet reduce the weight of safety-toe footwear measurably. No longer should the weight of safety-toe footwear lead to fatigue complaints among workers.

And even further weight reductions are coming. A new American footwear manufacturer soon will be entering the safety-toe market with footwear manufactured according to a technique that has been employed in West Germany. This new footwear will be highly flexible, and have a larger steel toe box that affords greater levels of protection. Yet, the footwear will weigh approximately 35 per cent less than the standard models now being sold.

Minimum Requirements for Safety-Toe Footwear According to the Revised Z-41 Standard

Classification	Compression (Pounds)	Impact (Foot Pounds)	Clearance (Inches)
75	2,500	75	16/32
50	1,750	50	16/32
30	1,000	30	16/32

Changes in Standards for Safety Footwear

The American National Standards Institute (ANSI) has created a voluntary standard for safety-toe footwear manufactured in the U.S. The standard was developed by a committee of manufacturers, retailers, consumers, and technical experts on such footwear.

Amendments recently have been made in the Z-41 standard, and the new standard should be published shortly. The changes include:

- **New women's standard** – To meet the Z-41 standard, a minimum clearance (between the toe and the steel box) must remain in the toe box after testing. This clearance has, in the past, been one-half inch for all safety-toe footwear, making no distinction between footwear for men or women. The new standard, however, will provide for a minimum clearance of one-half inch for men's safety-toe footwear and a new 15/32 inch level for women's footwear.
- **New ratings** – Ratings of safety-toe footwear now will distinguish between results of the compression test and the impact test, as opposed to a single rating for both tests, which existed previously.
- **New test methods** – A change has been made in the measurement of the impact test to provide a more accurate measurement of the impact force.

How AFIA Serves Safety

The American Footwear Industries Association (AFIA) is a non-profit trade association located at Washington, DC, whose members account for approximately 90 percent of the non-rubber footwear produced in the U.S., and a substantial number of suppliers to the industry.

One AFIA effort that is of special interest to safety specialists is its safety-toe certification program. Under the AFIA program, safety-toe footwear must meet strict performance standards. Such standards are established by a committee consisting of footwear manufacturers, retailers, employers, employees using safety-toe footwear, government officials, and specialists in the area of footwear protection. Such certification assures the consumer of safety-toe footwear that the product he is buying is, indeed, a quality product.

AFIA also provides assistance and information on the footwear industry in such areas as marketing, finance, and economics/statistics.

The association conducts, in conjunction with the Department of Commerce, an aggressive export promotion program, which has seen exports nearly triple in three years.

In addition to its current vigorous efforts to extend the import control program covering non-rubber imports, AFIA has been working to increase the impact of the footwear industry on critical federal legislative and regulatory issues. The industry recently was successful in convincing the Environmental Protection Agency (EPA) to exempt leather scraps generated by the industry from hazardous waste regulations promulgated by EPA.

In addition, the footwear will offer a vulcanized sole that will eliminate potentially hazardous chemical or water leakage into the shoe. Sales of footwear manufactured using this technique have been extremely encouraging in Europe, and the new American manufacturer plans to offer this safety-toe footwear to the American public this summer.

Summary

These new developments in the area of safety footwear should allow firms to improve upon their current safety programs. Safety footwear long has been an extremely effective means of reducing foot injuries in the workplace; recent developments have made safety footwear even more effective.

AFIA is working with safety footwear manufacturers to ensure that high levels of effectiveness are consistently met. The wide variety of safety shoes now available offers the consumer a safety shoe for almost any occupation, with any style preference. There truly is no reason why future surveys conducted by the Department of Labor's Bureau of Labor Statistics or any other group should cite large numbers of foot injuries—which could have been prevented through the use of safety shoes. Employers should find it easier to "sell" their employees on safety footwear—the base of any safety program. ◻

Frederick A. Meister has served as President of AFIA since January 1978. He had previously served as Vice-President for Public Affairs for Frontier Airlines, and also held positions in the U.S. Department of Transportation, where he received a number of awards for superior achievement. He also was awarded a Certificate of Appreciation for his achievements while working in the White House Office of Management and Budget. Mr. Meister holds a B.A. degree and Phi Beta Kappa honors from the University of Minnesota, and a Master of Arts degree from the University of California, Santa Barbara.

APPENDIX D
PRESENTATION PACKET

REASON FOR PROPOSAL

- AGC - LETTER OF SUPPORT

  ADVANCEMENT IN CONSTRUCTION RELATED TECHNOLOGY

  LOSS OF SKILLED LABOR

- IDAHO EMPLOYMENT LABOR REPORT - MAY 1988

  ALL AREAS OF CONSTRUCTION SEEM TO BE ON THE GO AS HOUSES, COMMERCIAL BUILDINGS, AND HIGHWAYS ARE BEING BUILT ACROSS THE STATE.

- AREA EMPLOYMENT NEWSLETTER - IDAHO FALLS - MARCH 1988

  . . . SIS PROJECT $937 MILLION

  PEAK CONSTRUCTION ESTIMATES 400 JOBS

- IDAHO EMPLOYMENT LABOR REPORT - APRIL 1988

  EMPLOYMENT INCREASES IN THE MINING SECTOR:

. . . WAS A CONTINUATION OF EXPANSION AT BOTH THE METAL AND NONMETALLIC MINES

. . . LABORFORCE OF ABOUT 70 WORKERS INCREASING TO 200 WITHIN A YEAR.

- ROAD CONSTRUCTION REPORT - IDAHO DEPARTMENT OF TRANSPORTATION, JUNE, 1988

  SHOWS 39 HIGHWAY CONSTRUCTION PROJECTS UNDERWAY.

- CONSTRUCTOR MAGAZINE - NOVEMBER 1987

  PREDICTS 890,000 NEW JOBS NATIONALLY IN THE CONSTRUCTION INDUSTRY BY THE YEAR 2000.

ABSTRACT

THE CONSORTIUM OF AREA VOCATIONAL EDUCATION SCHOOLS (CAVES) IS BEING FUNDED TO PROVIDE ASSISTANCE TO THE RAPIDLY EXPANDING CONSTRUCTION AND MINING INDUSTRIES IN IDAHO. THIS PROJECT WILL ENHANCE THE COORDINATION BETWEEN BOTH PRIVATE AND PUBLIC AGENCIES AND VOCATIONAL EDUCATION. JUST THE WRITING OF THIS PROPOSAL REGENERATED COOPERATIVE PLANNING AMONG VOCATIONAL EDUCATION AND THE ASSOCIATED GENERAL CONTRACTORS ASSOCIATION, FEDERAL BUREAU OF APPRENTICESHIP AND TRAINING, STATE DEPARTMENT OF LABOR AND INDUSTRIAL SERVICES, FIVE MINING COMPANIES IN NORTHERN IDAHO, AND THE STATE DEPARTMENT OF COMMERCE.

THIS STATEWIDE PROGRAM IS DIRECTED TOWARD THE FIVE BASIC CONSTRUCTION TRADES AND MINERS IN UNDERGROUND OPERATIONS. IT WILL SERVE AN ESTIMATED TOTAL OF 774 PARTICIPANTS AND ESTABLISH KNOWLEDGEABLE VOCATIONAL EDUCATIONAL PEOPLE IN EACH POSTSECONDARY SCHOOL TO CONTINUE THE COORDINATION WITH THESE TWO INDUSTRIES AFTER THE COMPLETION OF THE GRANT.

THIS PROJECT WILL ASSIST IN THE ESTABLISHMENT OF THE FIRST MINER APPRENTICESHIP PROGRAM IN THE UNITED STATES. IT WILL IDENTIFY AND TRAIN FEMALES AND MINORITIES TO ASSIST CONTRACTORS TO MEET THEIR EEO COMPLIANCE ON FEDERALLY FUNDED CONSTRUCTION PROJECTS. IT WILL PROVIDE TECHNICAL PROGRAMS FOR THE UPGRADING OF JOURNEYMEN CONSTRUCTION WORKERS. ALSO INCLUDED ARE PREAPPRENTICESHIP PROJECTS FOR 250 INDIVIDUALS STATEWIDE TO ENSURE THE CONTINUED PLACEMENT OF QUALIFIED PERSONNEL IN THE CONSTRUCTION AND MINING INDUSTRY.

COOPERATIVE
DEMONSTRATION PROJECT
JANUARY 1989 - JUNE 1990
(18 MONTHS)

PROJECT PARTNERS

- ASSOCIATED GENERAL CONTRACTORS
- BUREAU OF APPRENTICESHIP & TRAINING
- DEPARTMENT OF LABOR & INDUSTRIAL SERVICES
- CONTRACTORS
- MINING COMPANIES
- CAVES
- DEPARTMENT OF COMMERCE
- LABOR
- OTHERS

BUDGET

SALARY AND WAGES		$134,540
1.	2.5 CONSTRUCTION COORDINATOR/INSTRUCTOR .5 MINING CONSTRUCTION COORDINATOR .5 CONSTRUCTION SPECIALIST	
2.	FRINGE BENEFITS 23%	30,139
3.	TRAVEL	6,493
4.	SUPPLIES	3,472
5.	CONTRACTED SERVICES	
	CONSTRUCTION	96,000
	MINING	82,800
	EVALUATION	4,000
6.	OTHER	14,229
	TOTAL	371,673
	IN-KIND MATCH	$123,891

ACTIVITIES

PREAPPRENTICESHIP CLASSES

RELATED INSTRUCTION FOR CONSTRUCTION APPRENTICES

JOURNEYMEN UPGRADING

SAFETY INSTRUCTION

STAFF

PROJECT DIRECTOR	CAVES CHAIR
PROJECT COORDINATOR	CAVES SECRETARY
5 - .5 FTE CONSTRUCTION COORDINATOR/INSTRUCTOR	
1 - .5 FTE MINING CONSTRUCTION COORDINATOR/INSTRUCTOR	NIC
1 - .5 FTE CONSTRUCTION AND MINING SPECIALIST	STATEWIDE

STAFF TRAINING

?

FOUR FULL DAYS

- SAFETY
- APPRENTICESHIP
- CONSTRUCTION CODE
- MINING
EVALUATION

PROGRAM OPERATION

- LOCAL ADVISORY COMMITTEES
  - CONSTRUCTION/MINING
  - CONTRACTOR ASSOCIATIONS
  - BAT
  - OTHERS
- LABOR MARKET NEEDS ASSESSMENT

SUBPROPOSALS
(APPLICATIONS)

- CAVES FORM 43
    - STATEMENT OF NEED
    - COURSE OUTLINE
    - BUDGET NARRATIVE
- SUBMITTED TO:
    - DIRECTOR OF TRAINING
        - INTENT OF PROJECT
        - COSTS ARE JUST & REASONABLE
        - PERFORMANCE INDICATORS
        - EVALUATION
- CAVES - REVIEW & APPROVAL
- STATEWIDE ADMINISTRATOR - FINAL APPROVAL

FLAGGING/BASIC TRAFFIC CONTROL
CURRICULUM OUTLINE

Flagging

I. Responsibilities
   - A. Rules of conduct
   - B. Clothing and equipment
   - C. Certification

II. Basic Signals
   - A. Stopping traffic
   - B. Moving traffic
   - C. Slowing traffic

III. Position of Flaggers
   - A. Distance from crew at the work site
   - B. Stopping the first vehicle
   - C. Release of traffic
   - D. To slow traffic
   - E. Defensive flagging
     - 1. Awareness
     - 2. Eye contact
     - 3. Never turn your back on traffic
     - 4. Never walk between stopped vehicles
     - 5. Make yourself visible
     - 6. Give clear signals
     - 7. Always plan for escape
     - 8. Plan for the unexpected

IV. Stopping Distances of Vehicles

   - A. City conditions
   - B. Highway conditions
   - C. Hills
   - D. Heavy trucker problems

V. Night Flagging
   - A. Sign paddle reflectorized
   - B. Reflective tape and vest
   - C. Flashlight with red wand
   - D. Back-up flashlight
   - E. Generated lights
   - F. Battery operated strobe light
   - G. Reflective tape for gloves

VI. Flagging Systems
   - A. Additional flaggers
   - B. Signal lights
   - C. Baton method
   - D. Pilot car
   - E. Intersections
   - F. Emergency vehicles
   - G. Flags--emergency only

VII. Weather Conditions
  A. Effects of heat
  B. Vehicle traction

VIII. Signs
  A. Design and size of signs
  B. Illumination and reflectorization
  C. Position of signs--locations and height
  D. Erection of signs

IX. Channelizing Devices
  E. Striping tape, cones, tabular markers, vertical panels, drums, barricades, barriers and high level warning devices
  F. Function
  G. Channelization
  H. Cone design
  I. Cone application
  J. Vertical panel--design and application
  K. Drum design
  L. Drum application
  M. Barricade design
  N. Barricade application
  O. Portable barrier--design and application
  P. High level warning device--design and application
  Q. Pavement marking application
  R. Delineators

X. Traffic Control Practice
  S. Diagrams of basic traffic control systems
  T. Practice set up and take down of basic traffic control systems

Course Objective

The objective of this program is to establish uniform flagging and Basic Traffic Control standards and procedures that will not vary from job to job.

It has been proven that the construction industry is a dangerous occupation. For that reason total safety habits have to be developed to maintain proper working conditions for a safe but efficient operation at the job site; and to move traffic safely and expeditiously through or around the work areas.

This course will meet those standards established for flagger certification by the Idaho Department of Transportation and will be based upon procedures consistent with the Manual of Uniform Traffic Control.

Instructional Objectives

1. Clothing and Equipment

   Emphasize what equipment and clothing is necessary and relate how the safety of the flagger, work crew and the flow of traffic is contingent upon the visibility of the flagger.

2. Basic Signals

   Teach those signals that best convey to the driving public that a potential hazardous condition exists [illegible] the driver should react to that potential hazard.

3. Flagging Procedures

   Describe the procedures of flagging and the position of the flagger that both convey a proper message to the driver and protect the flagger from injury.

4. Signs

   Instruct on the placement of signs, distances from the work project, size and shape of signs. Emphasize their importance in warning and controlling drivers.

5. Channelizing Devices

   Demonstrate the use of channelizing devices for warning and guiding traffic in a safe manner through a job site area.

6. Traffic Control Application

   Diagram a complete traffic control system according to specifications.

Equipment

1. Personal Equipment

   Stop/slow paddle sign
   Orange vest--reflectorized
   Hard hat--orange
   Night equipment
   a. Reflectorized gloves
   b. Flashlight with red wand

2. Signs
   a. Road construction ahead
   b. One lane road ahead
   c. Flagman sign
   d. End construction
   e. Detour
   f. High level and low level warning
   g. Stop ahead
   Stands
   Sand bags

3. Channeling Equipment
   a. Cones
   b. Drums
   c. Striping tape
   d. Tabular markers
   e. Barricades

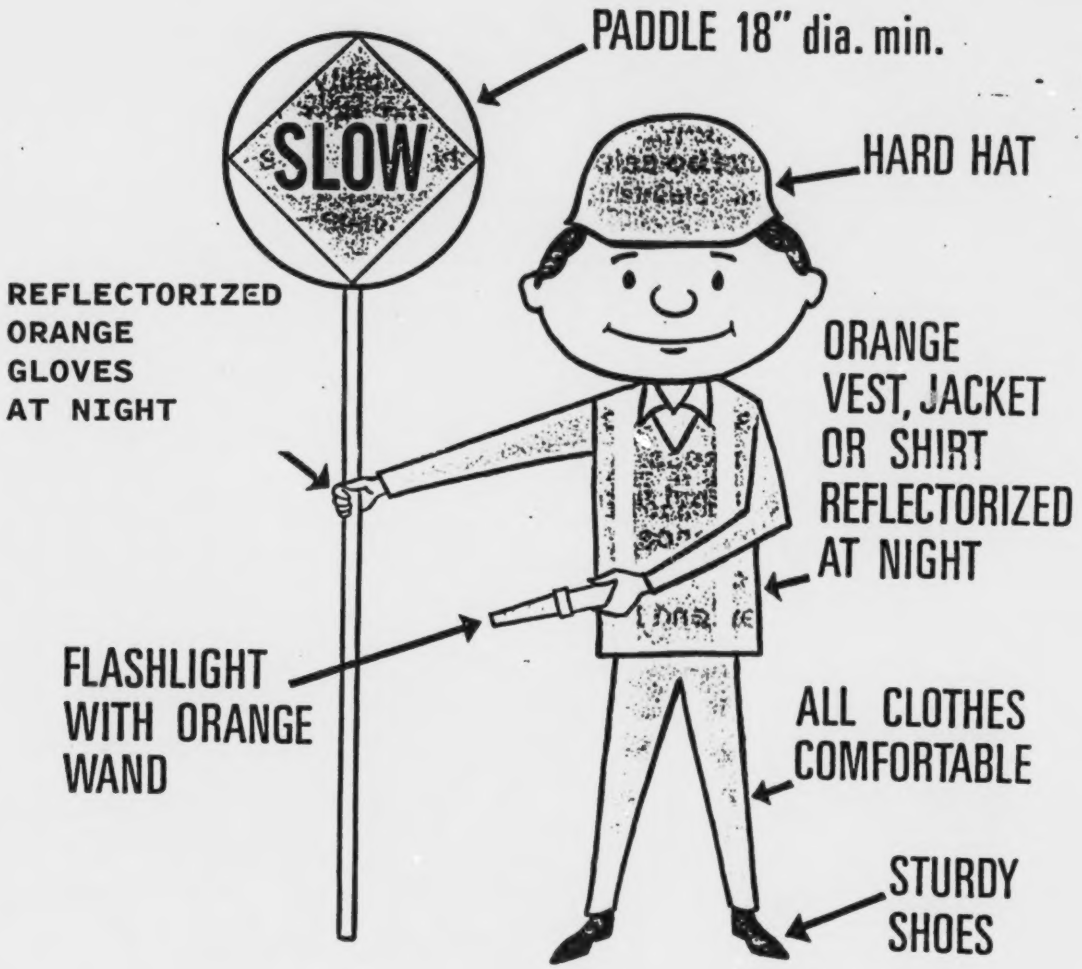
Written Materials

1. Idaho Flagging Manual
2. Traffic Control Workbook
3. Manual of Uniform Traffic Control Devices
4. Diagrams for Traffic Control

Audiovisual

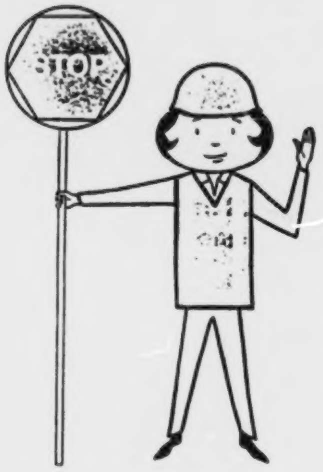
1. VCR film from Idaho Department of Transportation
2. Slides
3. Overlays
4. Flip chart

CLOTHING AND EQUIPMENT


PADDLE 18" dia. min.
SLOW
HARD HAT
REFLECTORIZED ORANGE GLOVES AT NIGHT
ORANGE VEST, JACKET OR SHIRT REFLECTORIZED AT NIGHT
FLASHLIGHT WITH ORANGE WAND
ALL CLOTHES COMFORTABLE
STURDY SHOES

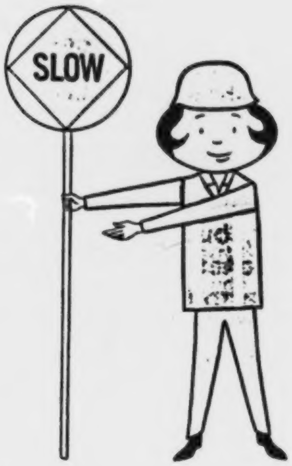
During warm weather flaggers should always wear shirts. Abbreviated clothing should never be worn.

BASIC SIGNALS



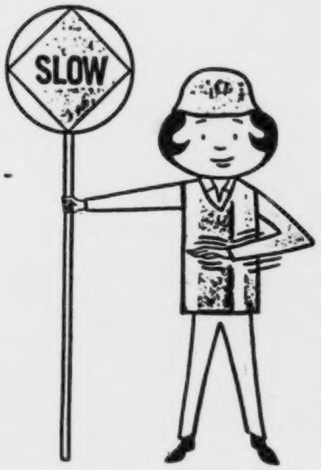
Stopping traffic:

1. Face the traffic.
2. Display the stop side of the paddle.
3. Extend the free arm with the palm raised toward approaching traffic.



Moving traffic:

1. Turn the paddle to the slow side.
2. Motion traffic through by slowly swinging your free arm across the front of the body at shoulder height.



Slowing traffic:

1. Display the slow side of the paddle.
2. Raise and lower your free arm at the elbow with palm down.

When traffic control is not necessary flaggers should position themselves on the shoulder of the road with the paddle turned parallel to the traffic flow.

The paddle is held in a stationary position away from the body with the arm extended horizontally. Keep the signals uniform and concise and look directly at the motorists. A sloppy signal could be confusing.

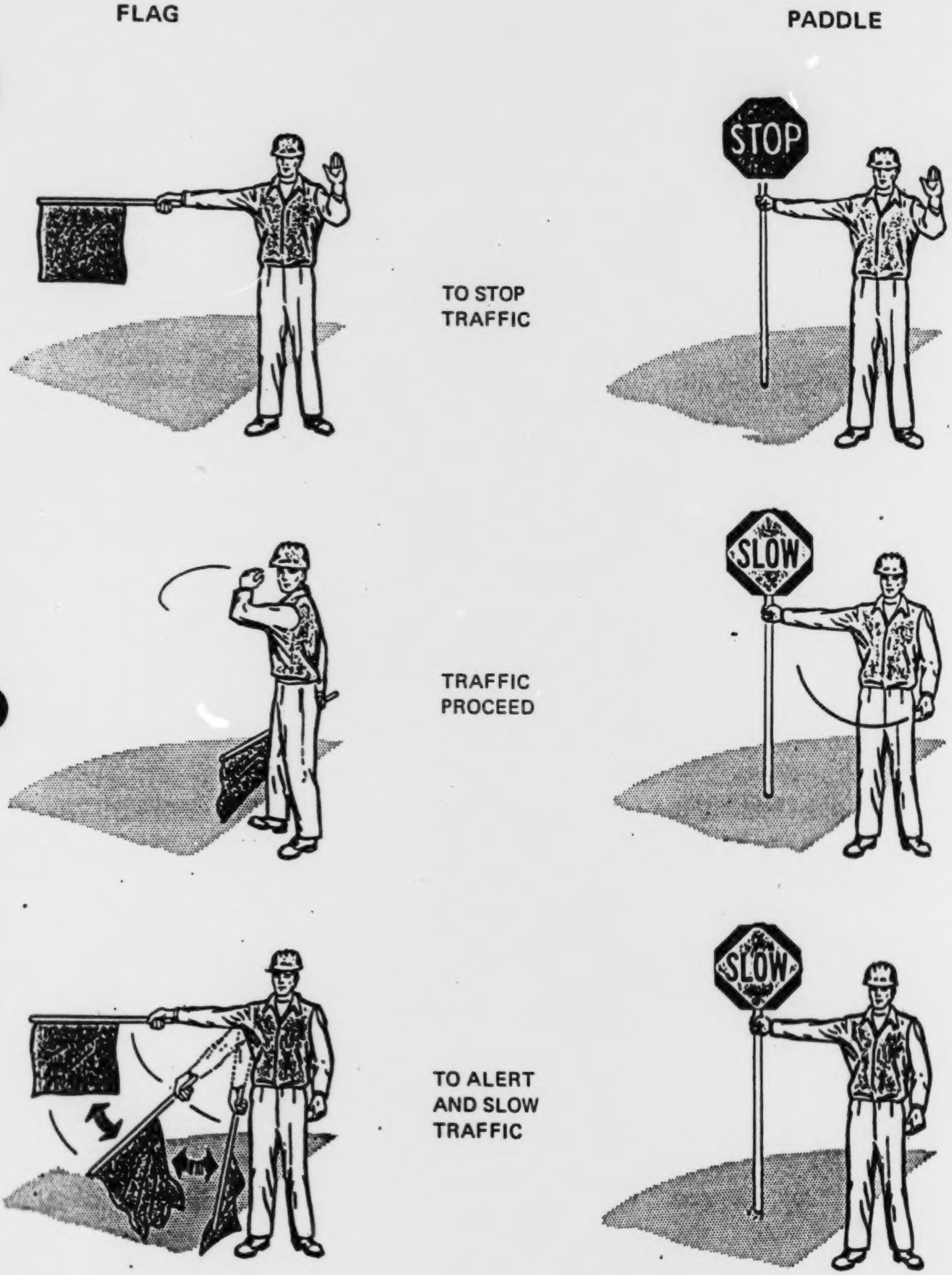
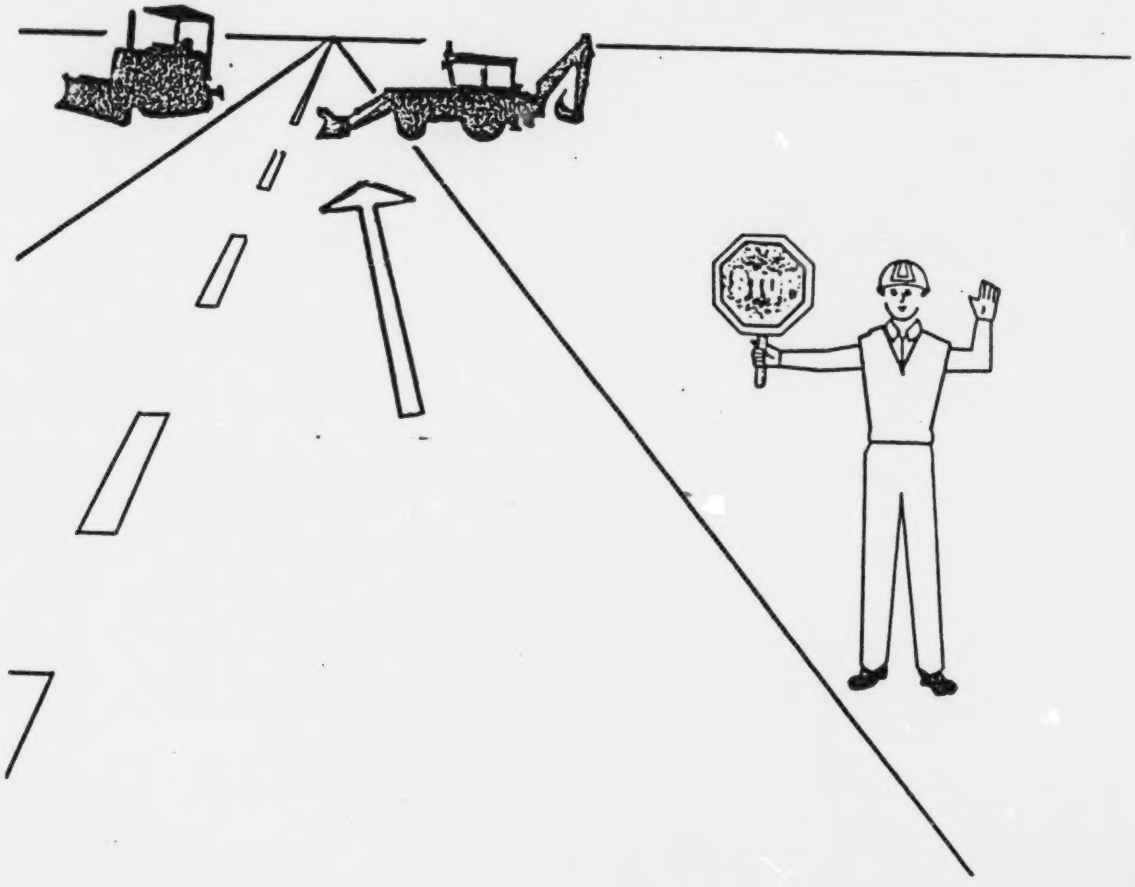

FLAG
PADDLE
STOP
TO STOP TRAFFIC
SLOW
TRAFFIC PROCEED
SLOW
TO ALERT AND SLOW TRAFFIC

Figure 6-6 Use of Hand Signaling Devices by Flagger (MUTCD, Figure 6-15)

YOUR POSITION

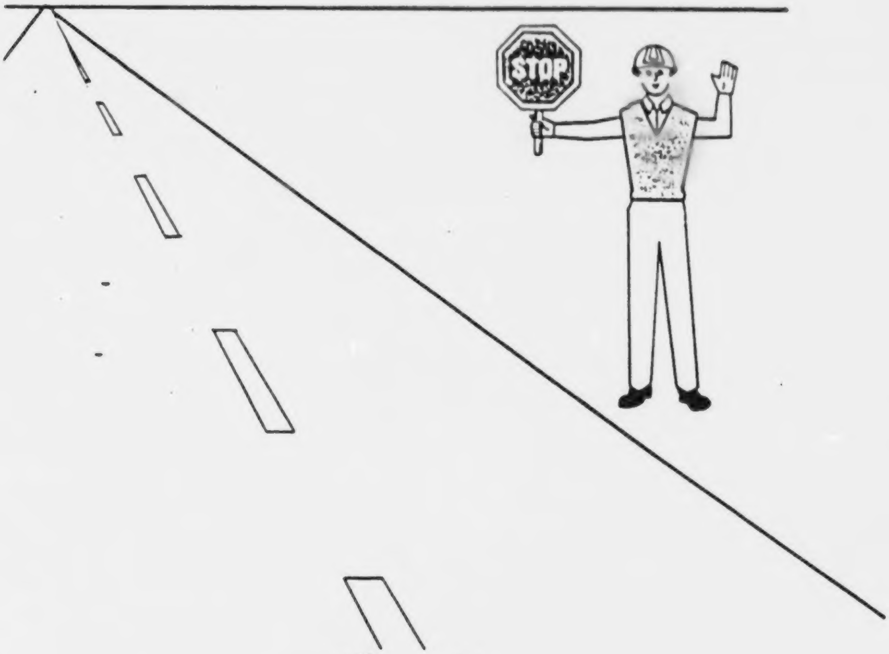
WHILE AWAITING ONCOMING TRAFFIC, THE FLAGGER SHOULD STAND IN A CONSPICUOUS POSITION ON THE SHOULDER OF THE ROAD, FACING THE DIRECTION OF THE APPROACHING VEHICLES. THE FLAGGER'S LOCATION SHOULD BE AT LEAST 200 TO 300 FEET IN ADVANCE OF THE CONSTRUCTION SITE. APPROACHING TRAFFIC MUST BE ABLE TO SEE THE FLAGGER FROM A MINIMUM OF 500 FEET IN EACH DIRECTION.



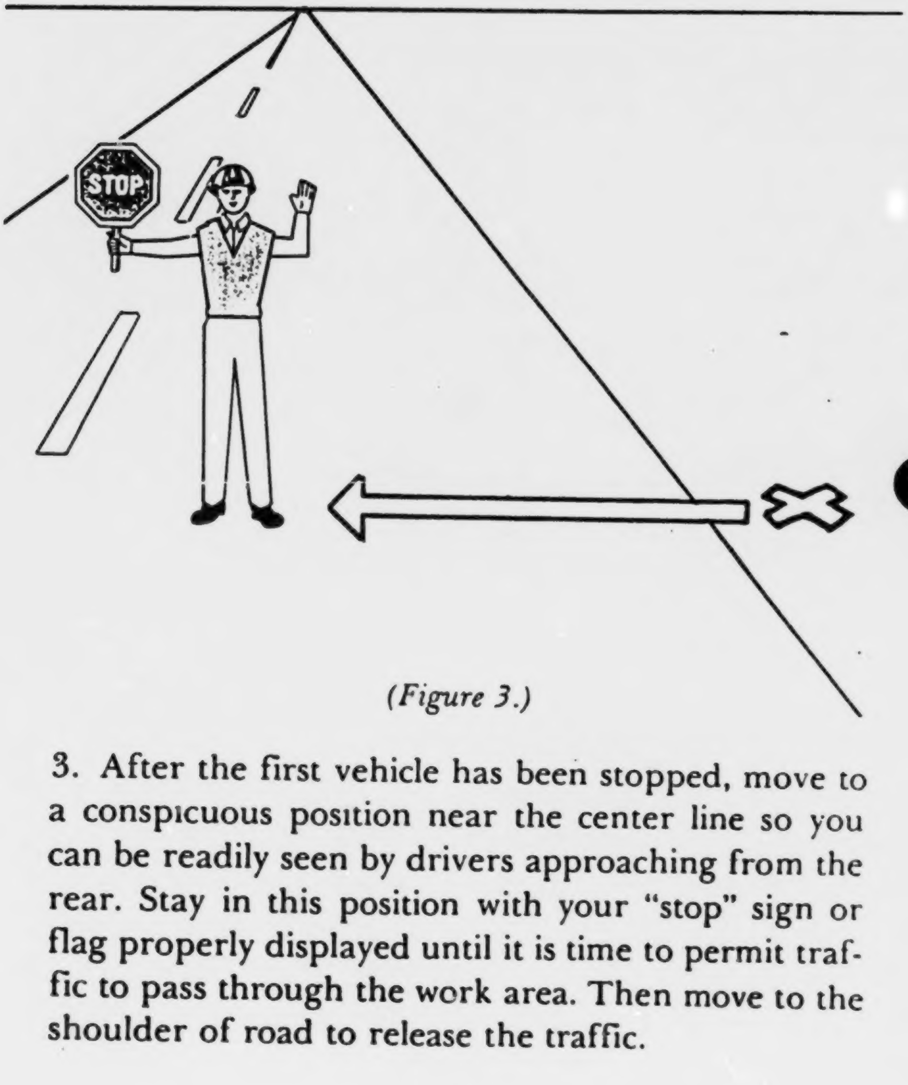
FLAGGING PROCEDURES

TO STOP TRAFFIC

1. Stand in a safe position on the shoulder facing traffic. If a stop/slow paddle is being used, the sign should be in the right hand with the arm raised to a horizontal position. Look directly at the approaching driver, and with the free arm upraised and the palm of the hand exposed to the driver, bring him to a stop.

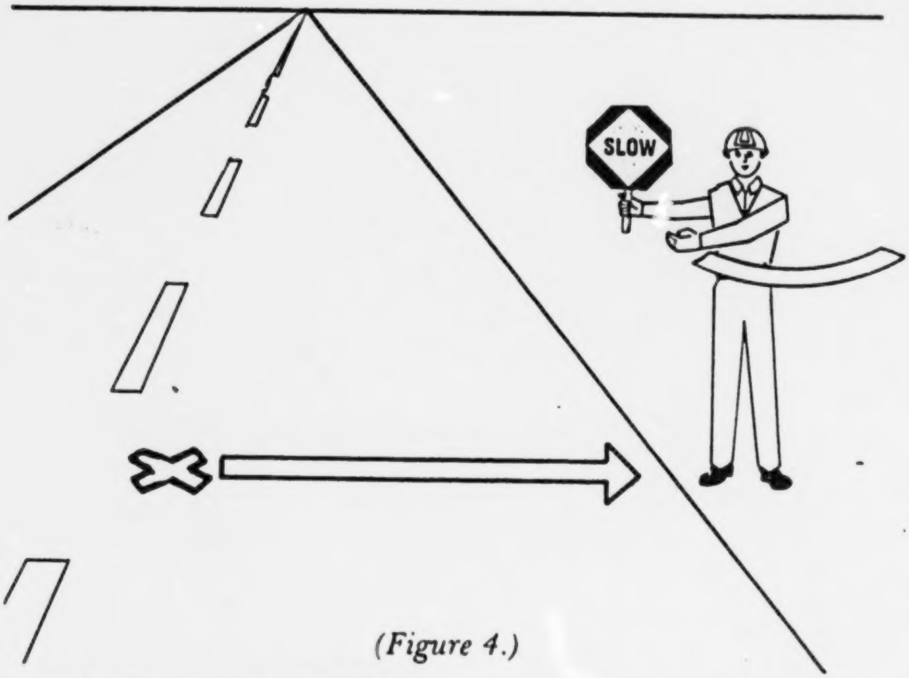


(Figure 1.)



(Figure 3.)

3. After the first vehicle has been stopped, move to a conspicuous position near the center line so you can be readily seen by drivers approaching from the rear. Stay in this position with your "stop" sign or flag properly displayed until it is time to permit traffic to pass through the work area. Then move to the shoulder of road to release the traffic.



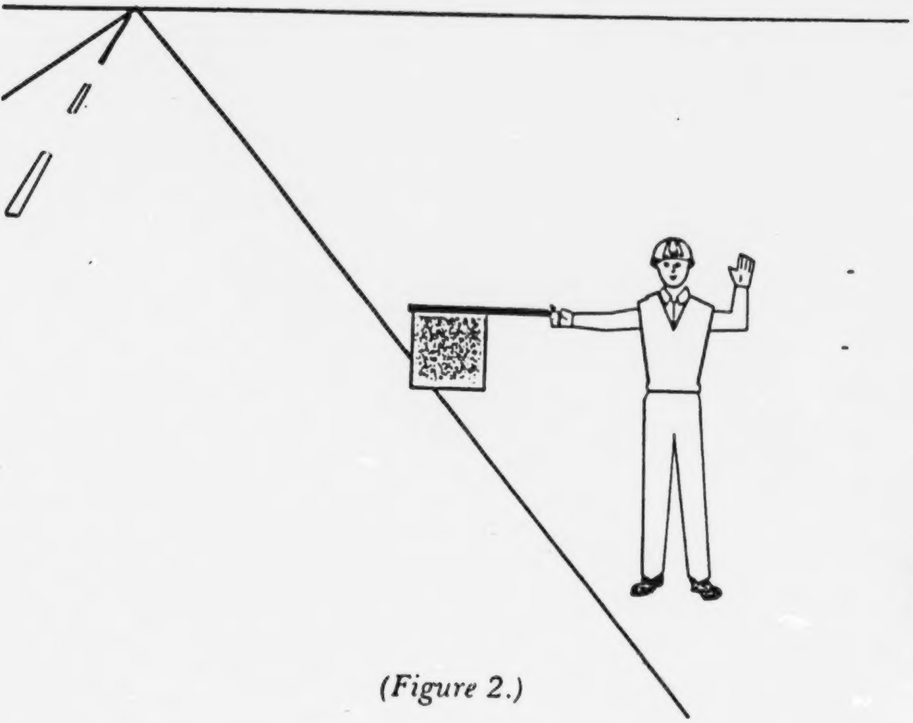
(Figure 4.)

TO RELEASE TRAFFIC

4. After moving to the shoulder of the road, show the "slow" side of the sign to the stopped vehicles. Then with your free hand, motion the traffic to proceed.

If you are using a flag, lower it so it is not visible to the traffic, then motion the vehicles ahead with your free hand.

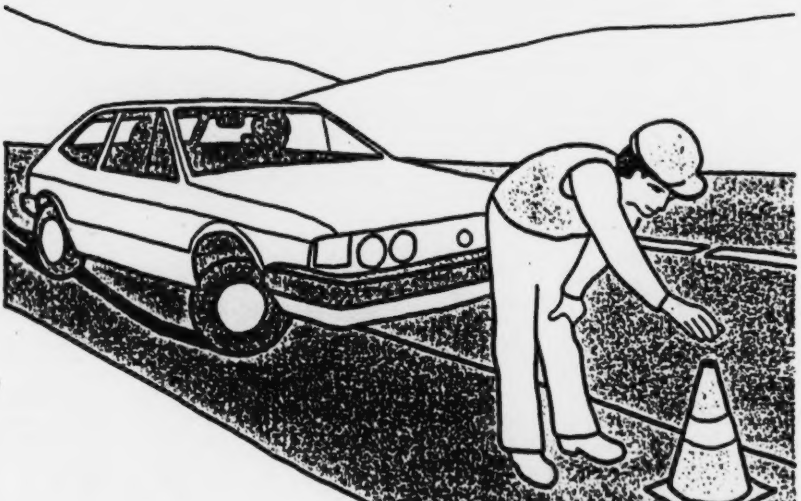
Never use a sign paddle or a flag to motion traffic ahead, as it only serves to confuse the drivers.



(Figure 2.)

IF A FLAG IS BEING USED, THE FLAGGER SHALL FACE TRAFFIC AND EXTEND THE FLAG HORIZONTALLY ACROSS THE TRAFFIC LANE IN A STATIONARY POSITION SO THAT THE FULL AREA OF THE FLAG IS VISIBLE BELOW THE STAFF. FOR GREATER EMPHASIS, THE FREE ARM SHOULD BE RAISED WITH THE PALM TOWARD APPROACHING TRAFFIC.

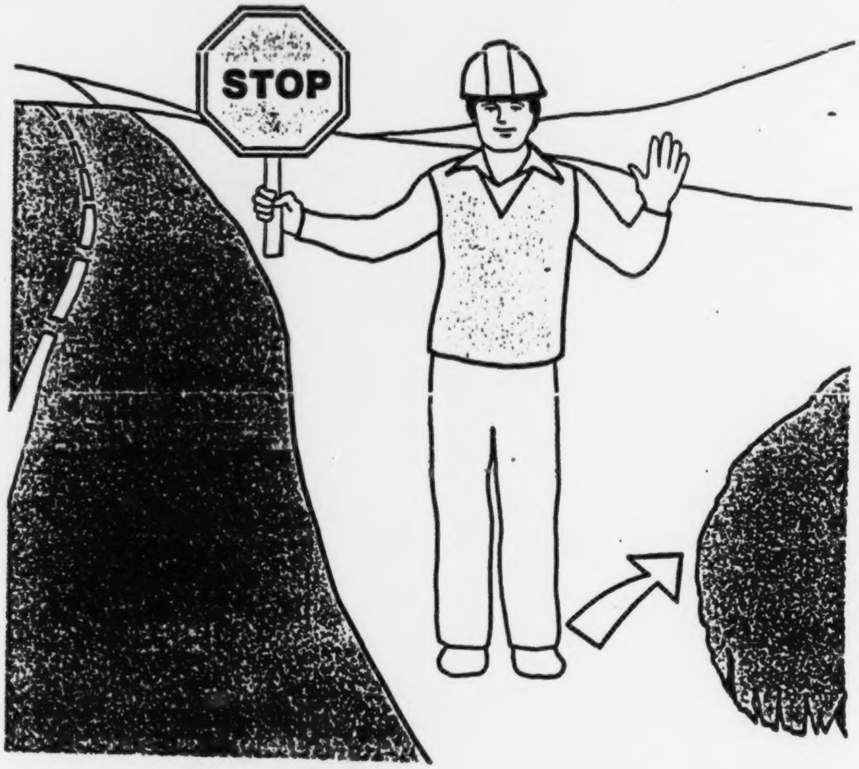
NEVER TURN YOUR BACK ON TRAFFIC



ALWAYS PLAN FOR ESCAPE

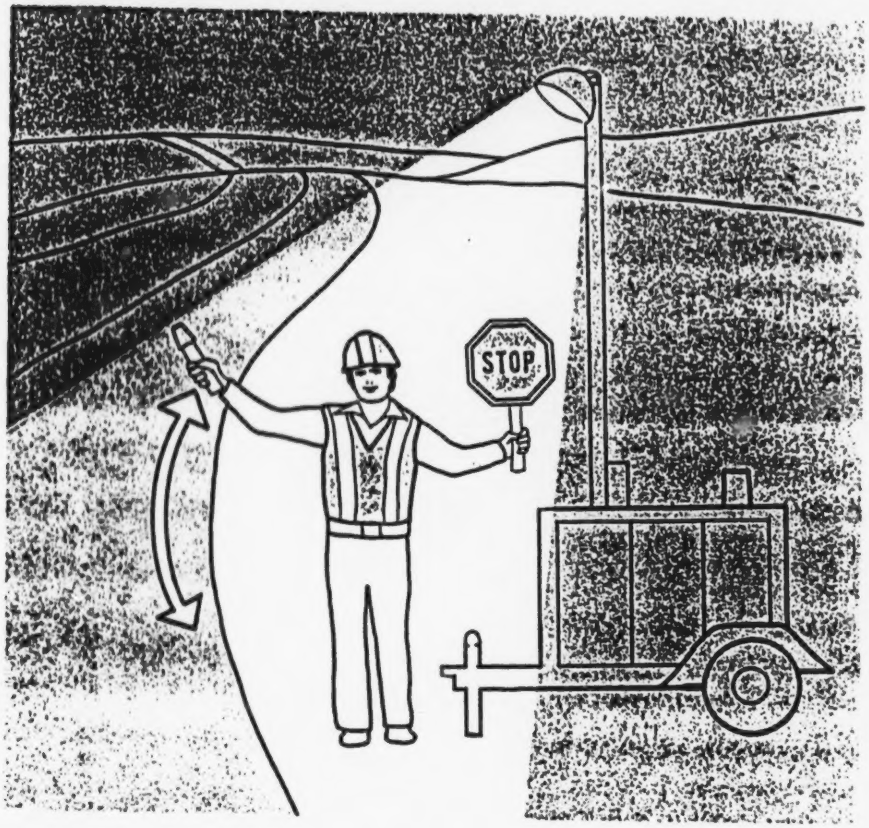
Assume the vehicle approaching will not stop or worse yet may panic and go out of control.

Do not flag from within an enclosed station where escape is limited.



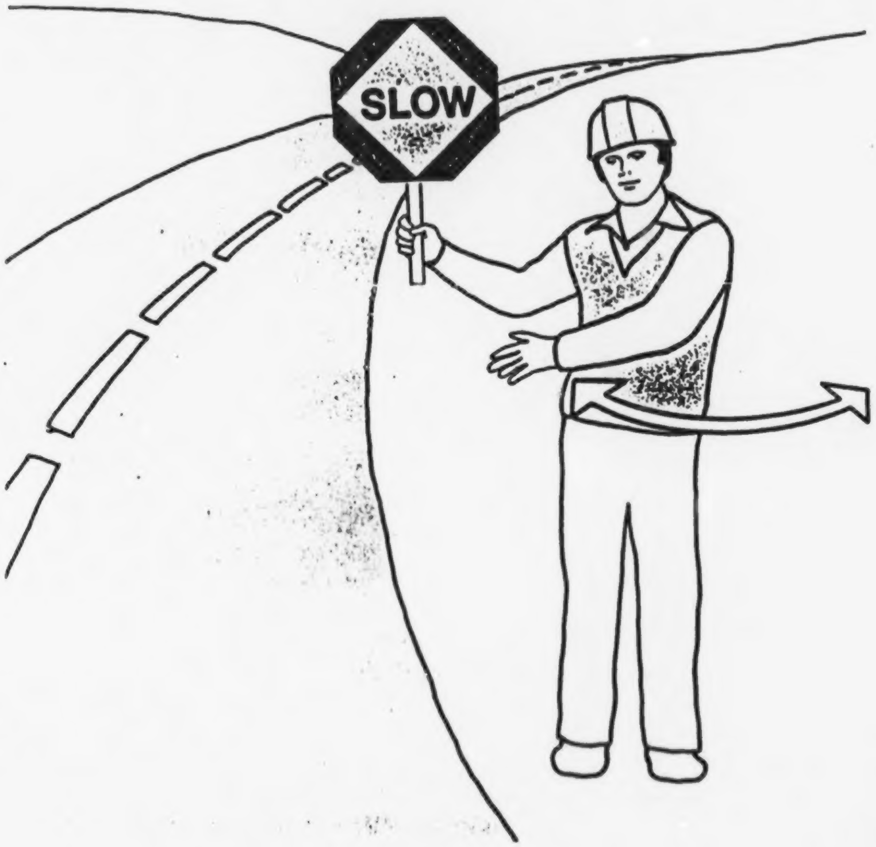
MAKE YOURSELF VISIBLE

Wear Vest.
Stand under lighted area at night.
Use movement to attract attention.



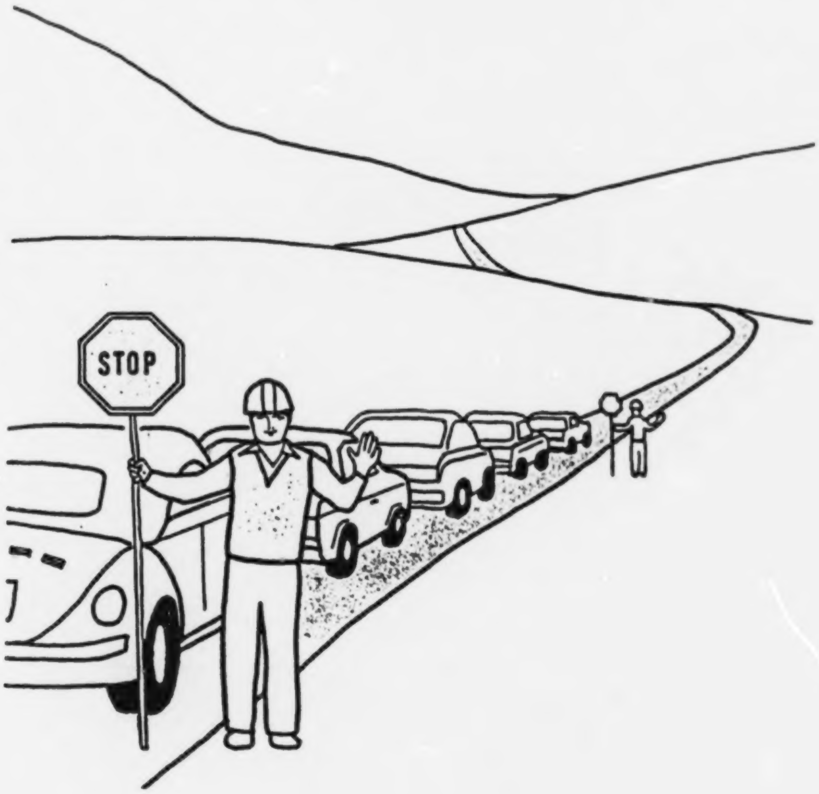
GIVE **CLEAR** SIGNALS

Don't wave your sign — use other hand to signal.
Make all signals with clear forcefulness.



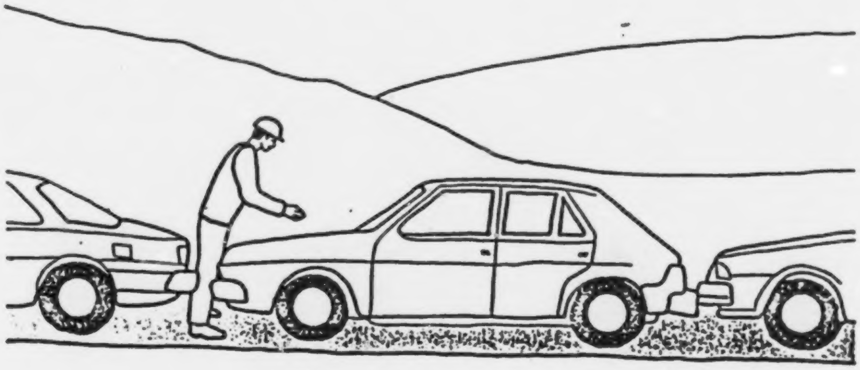
PLAN FOR THE UNEXPECTED

What if lightplant stops.
Flares for accident alert.
Escape routes.
What if too long a line backs up.



NEVER WALK BETWEEN STOPPED VEHICLES

IN 1972, A FLAGGER HAD BOTH LEGS BROKEN WHEN A TRUCK HIT THE BACK OF THE LINE AND PUSHED VEHICLES TOGETHER AS FLAGGER WAS WALKING BETWEEN THEM.



THE FLAGGER

Flaggers are responsible for the safety of the workers, motorists and themselves. Their job of controlling traffic can be one of the most important parts of an operation. Because of this tremendous responsibility and their contact with the public it is essential that only well qualified personnel be selected for this position.

A flagger should possess the following minimum qualifications:

- Average intelligence
- Good physical condition
- Mental alertness
- A courteous but firm attitude
- Neat appearance
- A sense of responsibility for the safety of the public, crew and themselves

Remember the flagger has three basic functions:

- To protect the lives of fellow workers
- To guide traffic safety through the work area
- To be courteous at all times

RULES OF CONDUCT

1. Flaggers should be positioned on the shoulder of the road facing the traffic. At times it may be necessary to stand on the opposite side of the road to be effective. Never stand in the traffic lane.
2. Plan an escape route in case of an emergency.
3. Be clearly visible to approaching traffic at all times.
4. If possible, never stand in the shade.
5. Stand alone, never permit a group of workers to congregate around you.
6. Choose a flagging position that will maintain color contrast between you, the background and the equipment.
7. Be alert and ready to respond to any emergency.
8. Acquaint yourself with the activities of the operation and be able to answer questions the motorists may ask.
9. Record the license number and description of any vehicle whose driver disobeys your instructions and threatens the safety of the work area.
10. Never try to flag from inside a vehicle.
11. Never strike a motorist's vehicle with the paddle or other device.
12. Don't involve yourself in unnecessary conversation with workers, pedestrians or motorists.
13. Don't lean, sit or lay on a vehicle.
14. Don't do other work or watch the operation in addition to flagging.
15. Don't step out into or turn your back on the traffic.
16. Never leave your position until relieved by a qualified flagger.
17. Never leave the "Flagger Ahead" sign up when the flagger is no longer needed.

F. CONTROL OF TRAFFIC THROUGH WORK AREAS

6F-1 Function

The primary function of traffic control procedures is to move traffic safety and expeditiously through or around work areas.

The control of traffic through work areas is an essential part of highway construction and maintenance operations. For these operations there must be adequate legislative authority for the implementation and enforcement of needed traffic regulations, parking controls and speed zoning. Such statutes must provide sufficient flexibility in the application of traffic control to meet the needs of the changing conditions in work areas.

Maintaining good public relations is necessary. The cooperation of the various news media in publicizing the existence of and reasons for work sites, therefore can be of great assistance in keeping the motoring public well informed.

6F-2 Hand Signaling Devices

A number of hand signaling devices, such as red flags, STOP/SLOW paddles and lights are used in controlling traffic through work areas. The flag is the most common device used during the daylight hours. The sign paddle bearing the clear messages STOP or SLOW also may be used.

Flags used for signaling purposes shall be a minimum of 24 by 24 inches in size, made of a good grade of red material securely fastened to a staff approximately 3 feet in length. The free edge should be weighted to insure that the flag will hang vertically, even in heavy winds.

Sign paddles should be at least 18 inches wide with letters at least 6 inches high. A rigid handle should be provided. This combination sign may be fabricated from sheet metal or other light semirigid material. The background of the STOP face shall be red with white letters and border. The background of the SLOW shall be orange with black letters and border. When used at night the STOP face shall be reflectorized red with white reflectorized letters and border, and the SLOW face shall be reflectorized orange with black letters and border.

6F-3 Flaggers

Since flaggers are responsible for human safety and make the greatest number of public contacts of all construction personnel, it is important that qualified personnel be selected. A flagger should possess the following minimum qualifications:

1. Average intelligence.
2. Good physical condition, including sight and hearing.
3. Mental alertness.
4. Courteous but firm manner.
5. Neat appearance.
6. Sense of responsibility for safety of public and crew.

The use of orange clothing such as a vest, shirt, or jacket shall be required for flaggers. For nighttime conditions similar outside garments shall be reflectorized.

Flaggers are provided at work sites to stop traffic intermittently as necessitated by work progress or to maintain continuous traffic past a work site at reduced speeds to help protect the work crew. For both of these functions the flagger must, at all times, be clearly visible to approaching traffic for a distance sufficient to permit proper response by the motorist to the flagging instructions, and to permit traffic to reduce speed before entering the work site. In positioning flaggers consideration must be given to maintaining color contrast between the work area background and the flagger's protective garments.

6F-4 Flagging Procedures

The following methods of signaling with a flag should be used:

1. *To Stop Traffic.* The flagger shall face traffic and extend the flag horizontally across the traffic lane in a stationary position so that the full area of the flag is visible hanging below the staff. For greater emphasis, the free arm may be raised with the palm toward approaching traffic.

2. *When it is Safe for Traffic to Proceed.* The flagger shall stand parallel to the traffic movement, and with flag and arm lowered from view of the driver, motion traffic ahead with the free arm. Flags shall not be used to signal traffic to proceed.

3. *Where it is Desired to Alert or Slow Traffic.* Where it is desired to alert or slow traffic by means of flagging, the flagger shall face traffic and slowly wave the flag in a sweeping motion of the extended arm from the shoulder level to straight down without raising the arm above a horizontal position.

If a sign paddel is used, it shall be held in a stationary position with the arm extended horizontally away from the body. For added emphasis, the flagger may slowly raise and lower the free hand with the palm down. The use of the flag and sign paddle are illustrated in figure 6-15.

Lights approved by the appropriate highway authority or reflectorized sign paddles or reflectorized flags shall be used to flag traffic at night. Daytime flagging procedures shall be followed whenever such lights, paddles or flags are used at night.

Whenever practicable, the flagger should advise the motorist of the reason for the delay and the approximate period that traffic will be halted. Flaggers and operators of construction machinery or trucks should be made to understand that every reasonable effort must be made to allow the driving public the right-of-way and prevent excessive delays.

6F-5 Flagger Stations

Flaggers stations shall be located far enough in advance of the work site so that approching traffic will have sufficient distance to reduce speed before entering the project. This distance is related to approach speed and physical conditions at the site; however 200 to 300 feet is desirable. In urban areas when speeds are low and streets closely spaced, the distance necessarily must be decreased.

The flagger should stand either on the shoulder adjacent to the traffic being controlled or in the barricaded lane. At a "spot" obstruction a position may have to be taken on the shoulder opposite the barricaded section to operate effectively. Under no circumstances should a flagger stand in the lane being used by moving traffic. The flagger should be clearly visible to approaching traffic at all times. For this reason the flagger should stand alone, never permitting a group of workers to congregate around the flagger station. The flagger should be stationed sufficiently in advance of the work force to warn them of approaching danger, such as out-of-control vehicles.

Flagger stations should be adequately protected and preceded by proper advance warning signs. At night, flagger stations should be adequately illuminated.

At short construction and maintenance lane closures where adequate sight distance is available for the safe handling of traffic the use of one flagger may be sufficient.

6F-6 One-Way Traffic Control

Where traffic in both directions must, for a limited distance, use a single lane, provision should be made for alternate one-way movement to pass traffic through the constricted section. At a "spot" obstruction, such as an isolated pavement patch, the movement may be self-regulating. However where the one-lane sectgon is of any length, there should be some means of coordinating movements at each end so that vehicles are not simultaneously moving in opposite directions in the section and so that delays are not excessive at either end. Control points at each end of the route should be chosen so as to permit easy passing of opposing lines of vehicles.

Alternate one-way traffic control may be effected by the following means:

1. Flagger control.
2. Flag-carrying or official car.
3. Pilot car.
4. Traffic signals.

6F-7 Flagger Control

Where the one-lane section is short enough so that each end is visible from the other end, traffic may be controlled by means of a flagger at each end of the section. One of the two should be designated as the chief flagger for purposes of coordinating movement. They should be able to communicate with each other verbally or by means of signals. These signals should not be such as to be mistaken for flagging signals.

Where the end of a one-lane section is not visible from the other end, the flaggers may maintain contact by means of radio or field telephones. So that a flagger may know when to allow traffic to proceed into the section, the last vehicle from the opposite direction can be identified by description or license.

6F-8 Flag-Carrying or Official Car

Flag carrying is effective when the route is well defined and nonhazardous. It should be employed only when the one-way traffic is confined to a relatively short stretch of road, usually not more than 1 mile in length.

The driver of the last vehicle proceeding into the one-lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that is is safe to allow traffic to move in the other direction. The flag being carried should always be clean and dry.

A variation of this method is the use of an "official" car which always follows the last vehicle proceeding through the section. The use of an official car eliminates the possibility of loss of the flag.

6F-9 Pilot Car

The use of a pilot car for traffic control can be most effective where the route is particularly hazardous, or so involved or frequently altered as to preclude adequate signing. The pilot car is used to guide a train of vehicles through the job or detour. Its operation must be coordinated with flagging operations or other controls at each end of the one-lane section. Sufficient turnaround room should be provided at these points. Provision should be made for identification of the last vehicle in the column.

The vehicle selected for pilot-car study should be light weight and easy to handle and should have the name of the contractor or contracting authority prominently displayed. The Pilor Car sign (sec. 6B-39) shall be mounted on the rear of the vehicle.

Two or more pilot cars may be used to guide two-way traffic through a particularly complex or hazardous detour.

6F-10 Traffic Control Signals

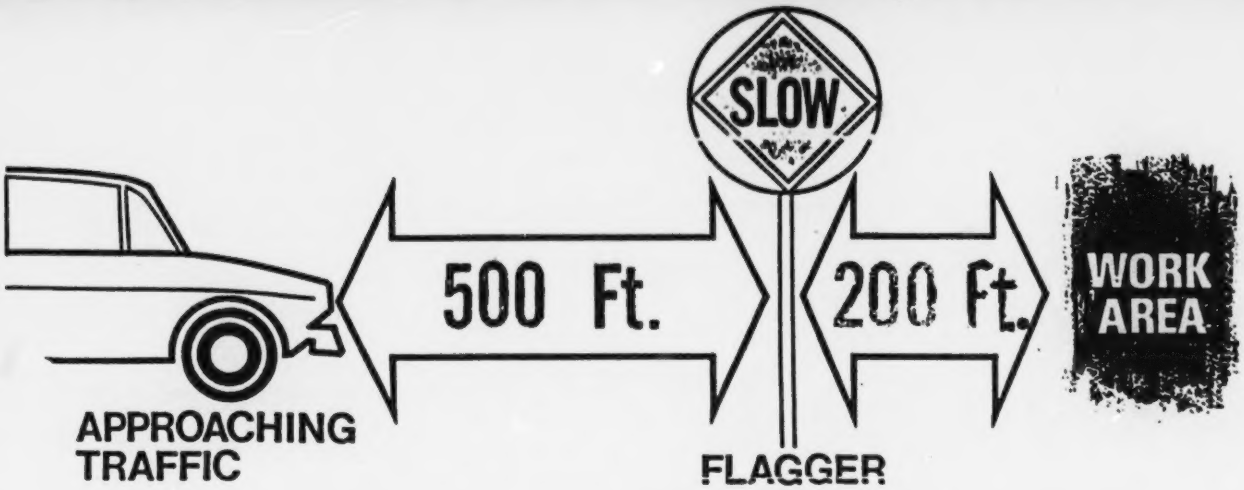
Traffic control signals may be used for special applications to control vehicular traffic movements at construction or maintenance work areas.

Typical applications include:

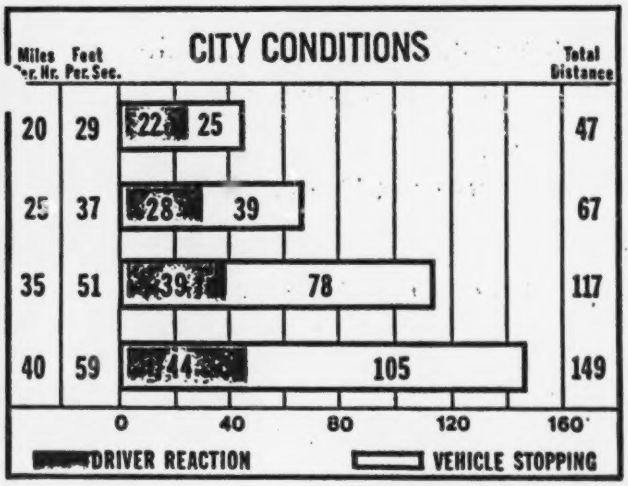
1. A highway or street intersection with a temporary "haul road" or equipment crossing.
2. Through areas requiring one-way traffic operations.

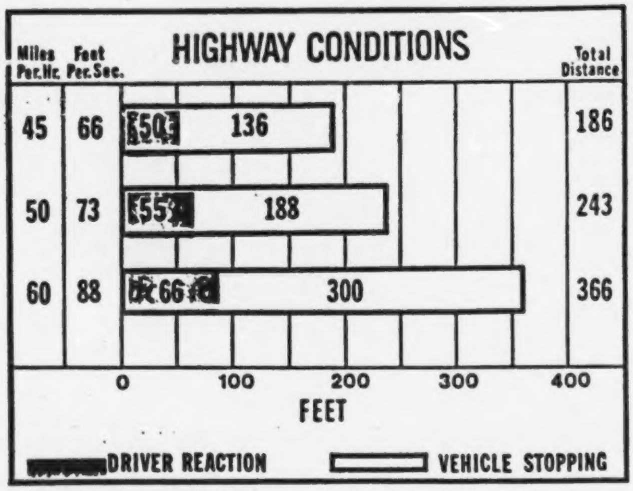
All traffic signal and control equipment shall meet the applicable standards and specifications prescribed in Part IV of this Manual. Normally, these installations shall be operated by means of traffic actuation or manual control.

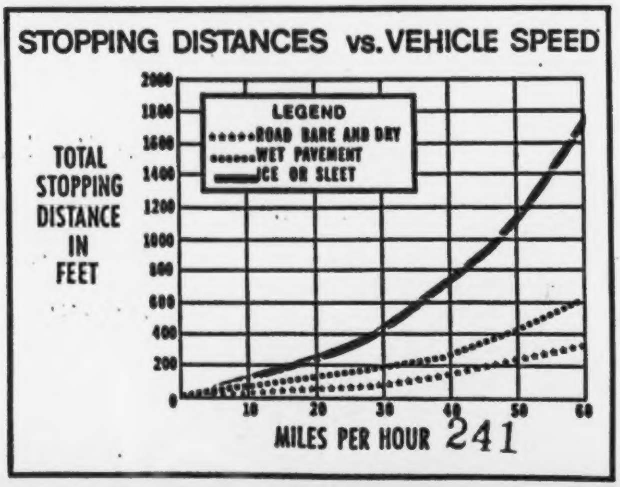
One-way traffic operation necessitates the use of an all-red interval of sufficient duration for traffic to clear the zone at the speed posted through the work area.


SLOW
500 Ft.
200 Ft.
WORK AREA
APPROACHING TRAFFIC
FLAGGER

Placement of warning signs is related to approach speed, weather and physical condition of the site. The "Flagger Ahead" sign should be 500 feet in advance of the flagger. The flagger should be stationed 200 feet in front of the work site. In urban areas the distance will be less, depending on traffic congestion, sideroads and other conditions. A warning signal should be established between the crew and flagger for use in emergency. For instance the word "Traffic" may be shouted loudly.







241

STOPPING DISTANCES

UNDER DIFFERENT ROAD CONDITIONS

(Measured in Feet)

M.P.H.	Dry Pavement	Gravel	Wet Pavement	Packed Snow	Ice or Sleet
30 ➡	88′	135′	147′	194′	430′
40 ➡	149′	232′	252′	336′	745′
50 ➡	243′	374′	404′	541′	1215′
60 ➡	366′	561′	607′	808′	1830′
70 ➡	532′	818′	882′	1184′	2648′

B. SIGNS

General

6B-1 Design of Signs

Street or highway construction and maintenance signs fall into the same three major categories as do other traffic signs; namely, Regulatory signs, Warning signs, and Guide signs. Many signs normally used elsewhere will also find application for signing construction and maintenance operations. Special construction and maintenance signs follow the basic standards for all highways signs as to shape. Warning signs in construction areas shall have a black legend on an orange background. Existing yellow warning signs already in place within these areas may remain in use. Color for other signs shall follow the standard for all highway signs.

The use of stripes (other than the standard border) or other geometric patterns or contrasting colors on or around any sign in an attempt to make it more conspicuous, distracts attention from the message, and defeats the purpose of maintaining uniformity and simplicity of design. Such practice is contrary to standards and is accordingly disapproved. However, the use of standard orange flags or yellow flashing warning lights in conjunction with signs is permitted, so long as they do not interfere with a clear view of the sign face.

The dimensions of signs shown herein are for standard sizes, which may be increased wherever necessary for greater legibility or emphasis. On secondary highways and city streets smaller signs may be used if authorized by lawful authority. Deviations from standard sizes as prescribed herein shall be in six-inch increments.

Standard sign sizes and colors are shown in the illustrations of the individual signs rather than in detailed specifications in the text. Where the orange background is specified and reflectorization is not required, a fluorescent material may be used for increased daytime visibility.

6B-2 Illumination and Reflectorization

All signs intended to be used during the hours of darkness shall be either reflectorized with a material that has a smooth, sealed outer surface, or illuminated to show approximately the same shape and color day and night. Where there is serious interference from extraneous light sources and a reflectorized installation is not likely to give effective performance, an illuminated sign should be used. Sign illumination may be either internal or external. When the full face of the sign is outlined by internal illumination, thereby indicating the shape of the

VI-11 (c)

sign, background reflectorization is not required. Where external illumination is provided, the light source should be properly shielded to protect drivers from glare. Street or highway lighting is not regarded as meeting the requirements for sign illumination.

6B-3 Position of Signs

Signs shall be placed in positions where they will convey their messages most effectively and placement must therefore be accommodated to highway design and alignment. Signs shall be so placed that the driver will have adequate time for response.

As a general rule signs shall be located on the right-hand side of the street or roadway. Where special emphasis is deemed necessary, dual installations may be made which consist of duplicate signs opposite each other on the left and right sides of the roadway, respectively. Within a construction or maintenance zone, however, it is often necessary and/or desirable to erect signs on portable supports placed within the roadway itself. It is also permissible to mount appropriate signs on barricades.

Standards for height and lateral clearance of roadside signs are shown in figure 6-1. Signs mounted on barricades, or temporary supports, may be at lower heights but the bottom of the sign shall be not less than one foot above the pavement elevation. Higher mounting heights are, however, desirable.

Where open highway conditions prevail on the approach to the work site, advance warning signs should be placed approximately 1,500 feet in advance of the condition to which they are calling attention. Where a series of advance warning signs are used, the warning sign nearest the work site should be placed approximately 500 feet from the point of restriction with the additional signs at 500-1000 foot intervals. On expressway and limited access facilities, the advance warning distance should be increased to one-half mile or more. On city streets, where more restrictive conditions generally prevail on the approach to the work area, signs in the immediate vicinity of the work may be placed at closer spacings. Typical sequences and spacings of advance warning signs are shown in figures 6-2 to 6-10.

6B-4 Erection of Signs

Signs on fixed supports are usually mounted on a single post, although those wider than 36 inches or larger than 10 square feet in area should generally be mounted on two posts. Signs mounted on portable supports are suitable for temporary conditions. All such installations should be so constructed to yield upon impact to minimize hazards to motorists.

For maximum mobility on certain types of maintenance operations, a large sign may be effectively mounted on a vehicle stationed in advance of the work or moving along with it. This may be the working vehicle itself, as in the case of shoulder-mowing or pavement marking equipment, or a vehicle provided expressly for this purpose. These mobile sign displays may be mounted on a trailer, may be provided with self-contained electric power units for flashers and lights, or may be mounted on a regular maintenance vehicle.

Guide signs, although ordinarily erected on separate posts, may also be mounted on or above barricades, but should not be permitted to interfere with the effectiveness of necessary regulatory and warning signs.

Typical methods of mounting signs other than on posts are shown in figure 6-11.

Regulatory Signs

6B-5 Authority

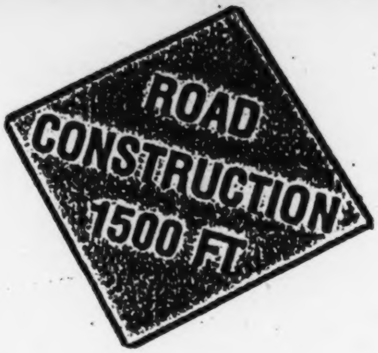
Regulatory signs impose legal obligations and/or restrictions on all traffic. It is essential, therefore, that their use be authorized by the public body or official having jurisdiction and that signs conform with this Manual.

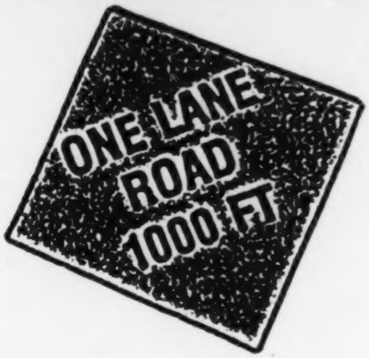
6B-6 Design

Regulatory signs are generally rectangular with their longer dimension vertical, and carry a black legend and border on a white background. The STOP sign is octagonal, and has a white legend and border on a red background. The YIELD sign is a white inverted triangle with red legend and border band. The DO NOT ENTER sign consists of a white square on which is inscribed a red circle with a white band horizontally across the center of the circle and the words DO NOT and ENTER in white letters on the upper and lower parts of the circle. The ONE-WAY sign may be either a horizontal or vertical rectangular plate, the latter being used more commonly in cities where space is limited. Commonly used regulatory signs are illustrated in figure 6-12. Design details for all regulatory signs are given in Part II.

6B-7 Application

Construction and maintenance operations represent unusual roadway conditions and warrant special attention. If construction or maintenance operations require regulatory measures different from those normally in effect, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory sign, taking into account applicable ordinances or statutes of the jurisdiction involved.

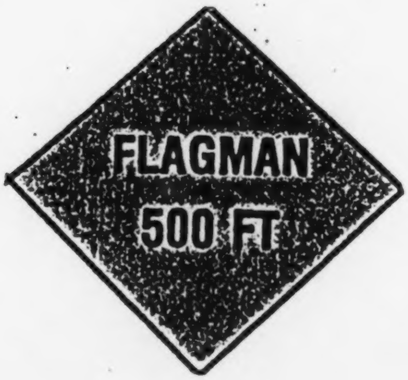

ROAD
CONSTRUCTION
1500 FT

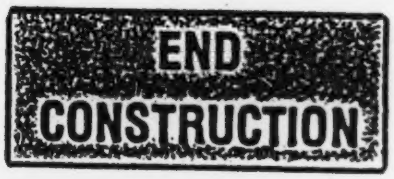

ONE LANE
ROAD
1000 FT

ADVANCE WARNING SIGNS

Adequate signs, flashing lights and barricades must appear in advance of the flagger, beginning with "Construction Ahead" at 1500′, "One Land Road" at 1,000′ and "flagger" 500′. These signs announce the flagger and prepare the traveling public for the road conditions existing ahead.

Signs should be removed or folded up when not in use. Signs should be moved along as the job progresses. Signs and distance vary where conditions warrant, be certain to check Federal, State and local regulations before any deviations are made.


FLAGMAN
500 FT


END
CONSTRUCTION

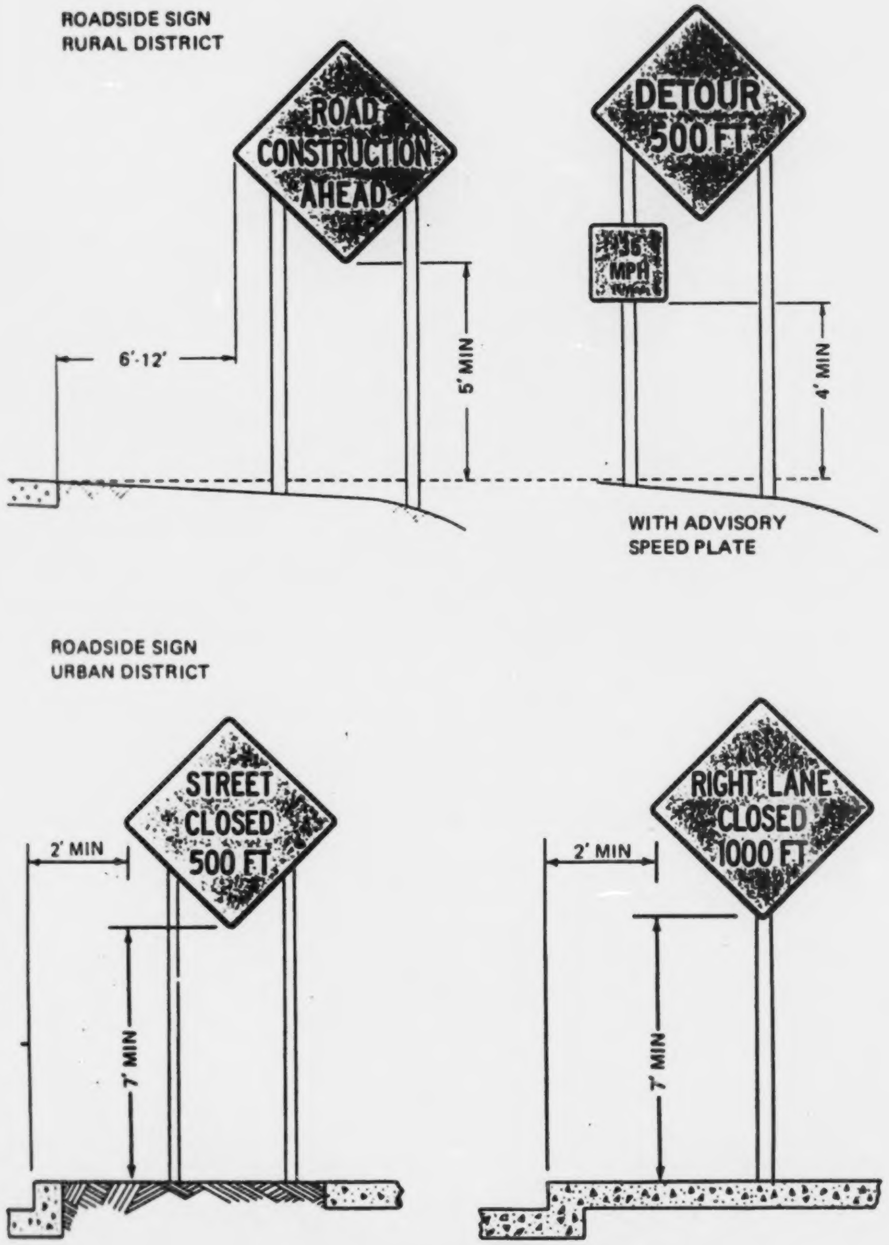
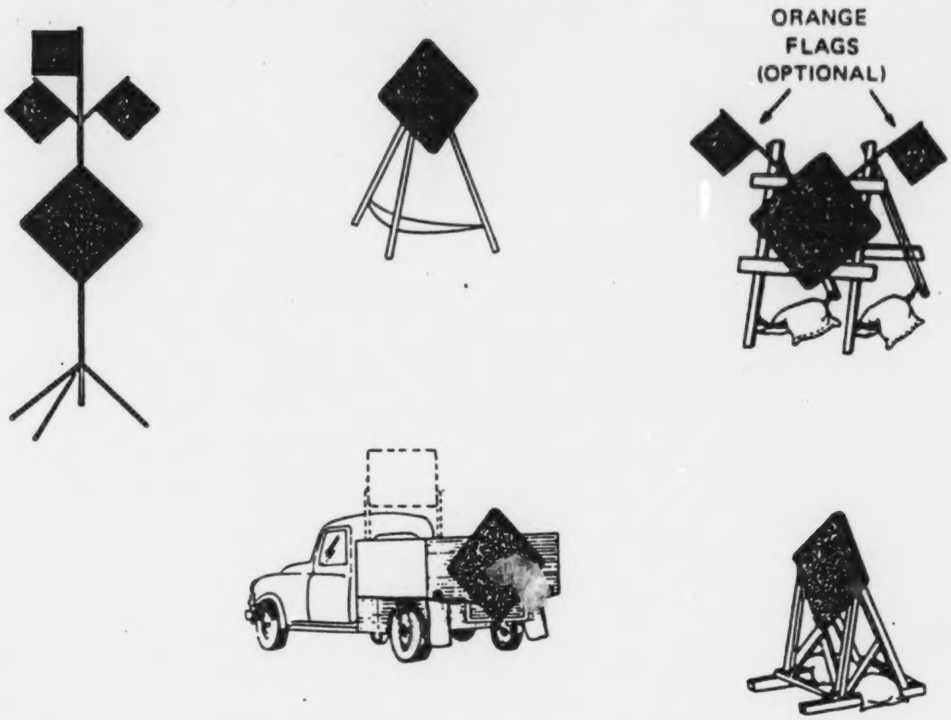

ROADSIDE SIGN
RURAL DISTRICT
ROAD CONSTRUCTION AHEAD
6'-12'
5' MIN
DETOUR 500 FT
35 MPH
4' MIN
WITH ADVISORY SPEED PLATE
ROADSIDE SIGN
URBAN DISTRICT
STREET CLOSED 500 FT
2' MIN
7' MIN
RIGHT LANE CLOSED 1000 FT
2' MIN
7' MIN

Figure 6-1. Height and lateral locations of signs—typical installation.

PORTABLE AND TEMPORARY MOUNTINGS


ORANGE
FLAGS
(OPTIONAL)

WING BARRICADES

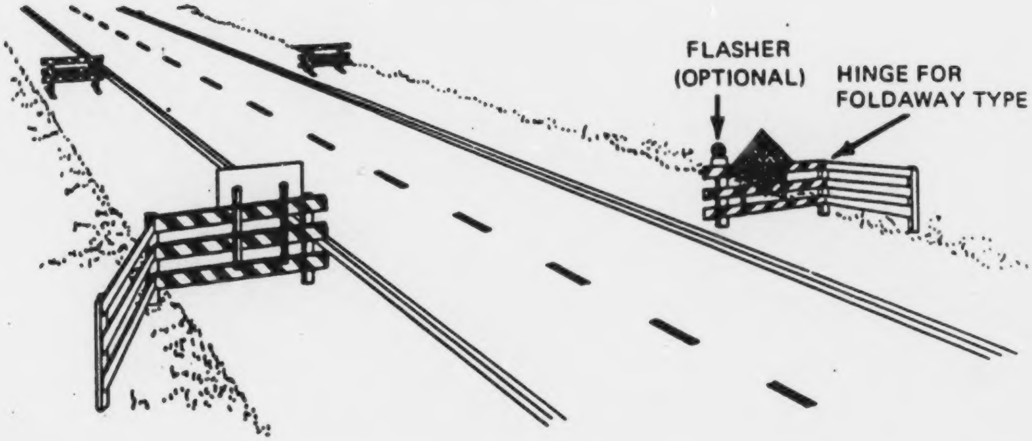

FLASHER
(OPTIONAL)
HINGE FOR
FOLDAWAY TYPE

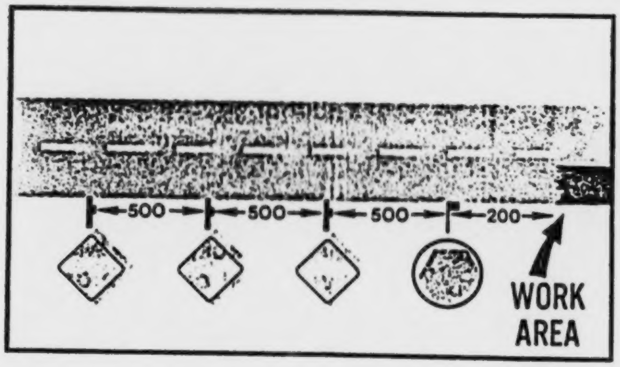
Figure 6–11. Methods of mounting signs other than on posts.

SIGN PLACEMENT

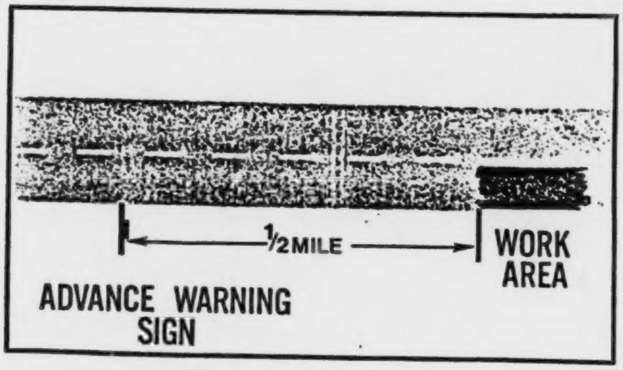
Warning signs must be placed to convey their messages effectively and give the driver adequate time to respond.

As a general rule they are placed at right angles on the right-hand side of the road.

When necessary warning signs shall be placed opposite each other on both sides of the road.



On the open highway the advance warning sign should be placed approximately 1,500 feet in advance of the condition to which they are calling attention. Additional warning signs should be placed at 500 foot intervals in the direction of the work area.



Freeway signs should be placed at least one-half mile in advance of the work area. If the flagging situation is dangerous, additional warning signs should be placed.

C. CHANNELIZING DEVICES

6C-1 Function

The functions of channelizing devices are to warn and alert drivers of hazards created by construction or maintenance activities in or near the traveled way, and to guide and direct drivers safely past the hazards. Channelizing devices as used herein includes but is not limited to cones, vertical panels, drums, barricades, and barriers.

Devices used for channelization should provide a smooth and gradual transition in moving traffic from one lane to another, onto a bypass or detour, or in reducing the width of the traveled way. They should be constructed so as not to inflict any undue damage to a vehicle that inadvertently strikes them. The objective should be the development of a traffic control plan which uses a variety of traffic control measures and devices in whatever combination necessary to assure smooth, safe vehicular movement past the work area and at the same time provide safety for the equipment and the workmen on the job.

Channelizing devices are elements in a total system of traffic control devices for use in highway construction and maintenance operations. These elements shall be preceded by a subsystem of warning devices that are adequate in size, number, and placement for the type of highway on which the work is to take place.

6C-2 Channelization

The single most important element, within the system of traffic control devices commonly used in construction or maintenance areas (where a reduction in pavement width is involved), is the taper that is provided for the channelization. An inadequate taper will almost always produce undesirable traffic operations with resulting congestion and possibly accidents through the area.

The minimum desirable taper length for construction and maintenance purposes should be computed by the formula $L=S\times W$, for all freeways, expressways, and other roadways having a posted speed of 45 m.p.h. or greater. The formula $L=WS^2/60$ should be used to compute taper length on urban, residential and other streets where the posted speeds are 40 m.p.h. or less. Under either formula, L equals the taper length in feet, W the width of offset in feet, and S the posted speed or off-peak 85 percentile speed.

The minimum desirable length derived from the appropriate formula above applies to roadway conditions of relatively flat grades and straight alignment. Adjustments may become necessary to provide adequate sight distance on the approach to the channelization. Similarly, the proximity of interchange ramps, crossroads, etc., to the work site may dictate the need for adjustments. In general, better traffic operations will result when the adjustments consist of increasing the length of the taper rather than reducing the length (below the minimum desirable recommended above).

The real test concerning adequate length of taper is the operation of vehicles through the transition. It should be long enough so that drivers of vehicles approaching side by side have sufficient length in which to adjust their respective speeds and merge into a single lane before-the end of the transition. A brief period of observing driver performances will generally provide some clear indications of the adequacy of the taper length. For example, if severe brake applications are observed, an increased taper length is indicated.

The maximum spacing between devices in a taper should be approximately equal in feet to the speed limit. For example, if the taper is on a roadway with an existing 55 MPH speed limit, the devices should be spaced about 55 feet. Devices placed on a tangent to keep traffic out of the closed lane should be spaced in accordance with the extent and type of activity, the speed limit of the roadway, and the vertical and horizontal alignment of the roadway such that it is apparent the roadway is closed to traffic.

On construction projects, channelization often remains in the same place for long periods of time. During such a long interval some of the elements—cones, barricades, barrels, etc.—get out of their original alignment due to being struck, moved due to construction activities, etc. It is necessary, therefore, to patrol the channelization at regular intervals to assure its proper functioning as a traffic control device. Replacement or shifting of the elements into the original alignment can best be done if the original positions of the elements had been indicated on the pavement by paint marks. This technique assures good alignment and proper vehicle performances over a long period of time with minimum expenditure of men and materials in maintaining the channelization.

Sometimes during maintenance operations, work at one site will extend over several days, thereby requiring that channelization be set up each morning and removed each evening. Under these circumstances the locations of the cones, barrels, etc., should be marked at the time of the original set-up to facilitate the rapid, orderly re-setting of the devices on each succeeding day.

6C-3 Cone Design

Traffic cones and tubular markers of various configurations are available. These shall be a minimum of 18 inches in height with a broadened base and may be made of various materials to withstand impact without damage to themselves or to vehicles. Larger size cones should be used on freeways and other roadways where speeds are relatively high or wherever more conspicuous guidance is needed. Orange shall be the predominant color on cones. They should be kept clean and bright for maximum target value. For nighttime use they shall be reflectorized or equipped with lighting devices for maximum visibility. Reflectorized material shall have a smooth, sealed outer surface which will display the same approximate color day and night.

Reflectorization of tubular markers shall be a minimum of two three-inch bands placed a maximum of 2'' from the top with a maximum of 6'' between the bands. Reflectorization of cones shall be provided by a minimum 6'' band placed a maximum of 3'' from the top.

6C-4 Cone Application

Included under this heading are a group of devices whose primary function is the channelization of traffic. They may be conical in shape, but there are also tubular shaped devices available capable of performing the same function. They may be set on the surface of the roadway or rigidly attached for continued use.

Traffic cones may be easily stacked on a truck and one workman can carry and distribute several cones with ease. This mobility and flexibility (which cannot be equalled by Type I barricades) increases the usefulness of these devices.

When cones are used, precautions are necessary to assure they will not be blown over or displaced. This may be particularly critical adjacent to lanes of moving traffic where there may be a wind created by passing vehicles. Some cones are constructed with bases that may be filled with ballast. With others it may be necessary to double the cones or use heavier weighted cones, special weighted bases, or weights such as sand bag rings that can be dropped over the cones and onto the base to provide increased stability. These added weights should not be sufficient to present a hazard if the devices are inadvertently struck.

In general, traffic cones have a greater target value than do the tubular shaped devices. However, the target value of either device may be enhanced during the day time by the insertion of an orange flag in the top and at night, by reflectorization or the use of lighting devices.

6C-5 Vertical Panel—Design and Application

Vertical panels used as channelizing or warning devices shall be 8 to 12 inches in width and a minimum of 24 inches in height. They shall be orange and white striped and reflectorized in the same manner as barricades and mounted with the top a minimum of 36 inches above the roadway. For panels less than 3' in height, 4'' stripes shall be used. If used for traffic in two directions back to back panels shall be used. These devices may be used for traffic separation or shoulder barricading where space is at a minimum.

Panels with stripes which begin at the upper right side and slope downward to the lower left side are to be designated as 'right' panels (VP-1R). Panels with stripes which begin at the upper left side and slope downward to the lower right side are to be designated as 'left' panels (VP-1L).

For nighttime use, it is desirable to place flashing warning lights on vertical panels when they are used singly and steady burn warning lights on vertical panels when they are used in a series for channelization.

6C-6 Drum Design

Drums used for traffic warning or channelization shall be approximately 36'' in height and a minimum of 18'' in diameter. The markings on drums shall be horizontal, circumferential, orange and white reflectorized stripes four to eight inches wide, using a material that has a smooth, sealed outer surface which will display the same approximate size, shape and color day and night.

There shall be at least two orange and two white stripes on each drum. If there are nonreflectorized spaces between the horizontal orange and white stripes, they shall be no more than two inches wide

6C-7 Drum Application

Drums are most commonly used to channelize or delineate traffic flow but may also be used singly or in groups to mark specific hazards. Drums are highly visible and have good target value, give the appearance of being formidable obstacles and, therefore, command the respect of drivers. They are portable enough to be shifted from place to place within a construction project in order to accommodate changing conditions but are generally used in situations where they will remain in place for a prolonged period of time. When drums are placed in the roadway, appropriate advance warning signs shall be used.

Drums should not be weighted with sand, water, or any material to the extent that would make them hazardous to motorists. When they are used in regions susceptible to freezing, they should have drain holes in the bottom so water will not accumulate and freeze causing a hazard if struck by a motorist.

During hours of darkness a flashing warning light should be placed on drums used singly and steady burn warning lights should be placed on drums used in a series for traffic channelization.

Small arrow signs or vertical panels mounted above drums may be used as supplements to drum delineation.

6C-8 Barricade Design

A barricade is a portable or fixed device having from one to three rails with appropriate markings used to control traffic by closing, restricting, or delineating all or a portion of the right-of-way.

Barricades shall be one of three types: Type I, Type II, or Type III. The characteristics of these types are shown in Figure 6-14 and Table VI-1.

Barricades with stripes which begin at the upper right side and slope downward to the lower left side are to be designated as 'right' (R) barricades. Barricades with stripes which begin at the upper left side and slope downward to the lower right side are to be designated as 'left' (L) barricades.

Markings for barricades rails shall be alternate orange and white stripes (sloping downward at an angle of 45 degrees in the direction traffic is to pass).

Where a barricade extends entirely across a roadway, it is desirable that the stripes slope downward in the direction toward which traffic must turn in detouring. Where both right and left turns are provided for, the chevron striping may slope downward in both directions from the center of the barricade.

Barricade rails should be supported in a manner that will allow them to be seen by the motorist and provide a stable support not easily blown over by the wind or traffic. For Type I barricades, the support may include other unstriped horizontal panels necessary to provide stability. The name of the agency, contractor, or supplier shall not be shown on the face parts of any barricade. Identification markings may be shown only on the back side of barricade rails.

The entire area of orange and white shall be reflectorized with a material that has a smooth, sealed outer surface which will display the same approximate size, shape and color day and night. The predominant color for other barricade components shall be white, except that unpainted galvanized metal or aluminum components may be used.

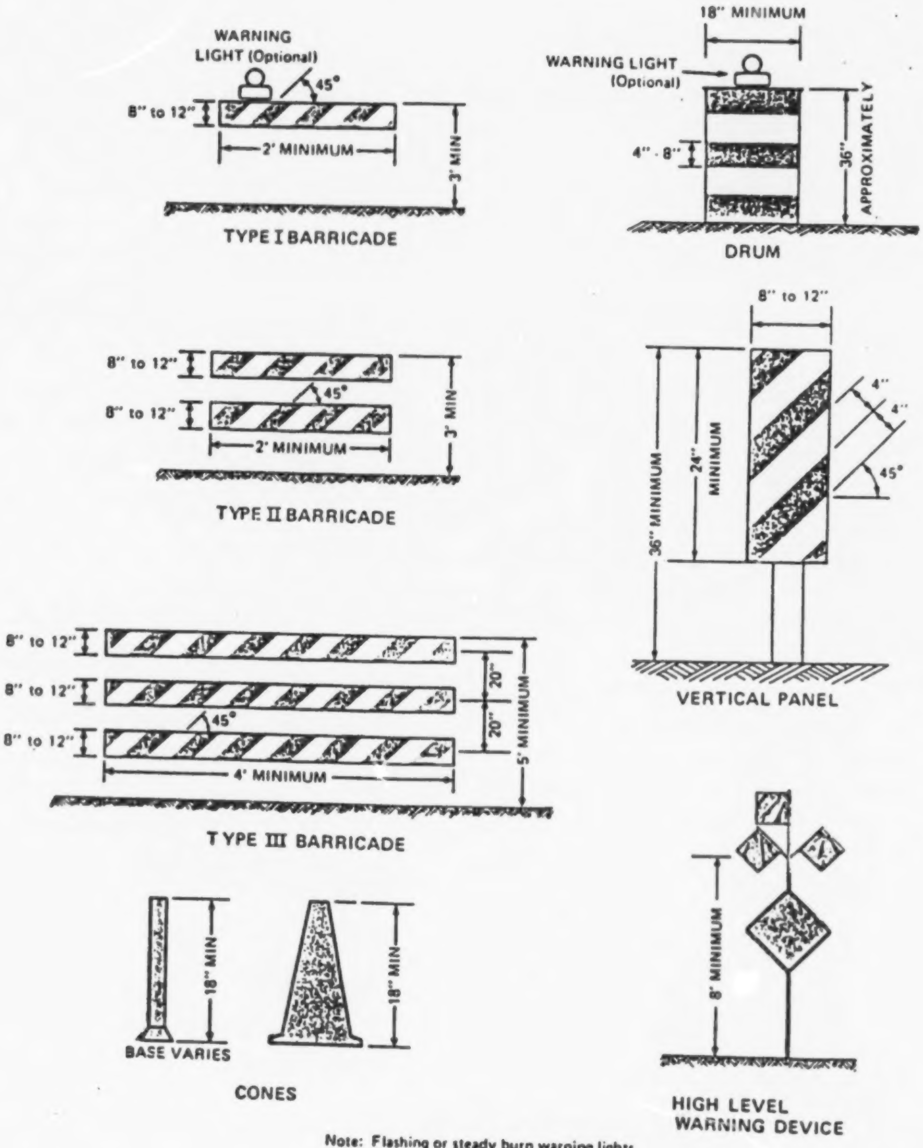
Barricades are located adjacent to traffic and therefore subject to impact by errant vehicles. Because of their vulnerable position and the possible hazard they could create, they should be constructed of lightweight materials and have no rigid stay bracing for "A" frame designs.

Table VI-1 Barricade Characteristics

	*Type**		
	I	*II*	*III*
Width of Rail	8" min-12" max	8" min-12" max	8" min-12" max
Length of Rail	2 ft. min	2 ft. min	4 ft. min
Width of Stripes**	6 in.	6 in.	6 in.
Height	3 ft. min	3 ft. min	5 ft. min.
Number of Reflectorized Rail Faces	2 (one each direction)	4 (two each direction)	3 if facing traffic in one direction 6 if facing traffic in two directions

* For wooden barricades nominal lumber dimensions will be satisfactory

** For rails less than 3 feet long, 4 inch wide stripes shall be used


WARNING
LIGHT (Optional)
45°
8" to 12"
2' MINIMUM
3' MIN
TYPE I BARRICADE
18" MINIMUM
WARNING LIGHT
(Optional)
4" - 8"
36" APPROXIMATELY
DRUM
8" to 12"
8" to 12"
45°
2' MINIMUM
3' MIN
TYPE II BARRICADE
8" to 12"
4"
4"
45°
24" MINIMUM
36" MINIMUM
VERTICAL PANEL
8" to 12"
8" to 12"
8" to 12"
45°
20"
20"
4' MINIMUM
5' MINIMUM
TYPE III BARRICADE
18" MIN
BASE VARIES
18" MIN
CONES
8' MINIMUM
HIGH LEVEL
WARNING DEVICE

Note: Flashing or steady burn warning lights should be used on barricades, panels, and drums as needed.

Figure 6-14. Channelizing devices and high level warning devices.

6C-9 Barricade Application

Type I or Type II barricades are intended for use in situations where traffic is maintained through the area being constructed and/or reconstructed. They may be used singly or in groups to mark a specific hazard or they may be used in a series for channelizing traffic. Type I barricades would normally be used on conventional roads or urban streets and arterials. As Type II barricades have more reflective area, they are intended for use on expressways and freeways or other high speed roadways.

On high speed expressways or in other situations where barricades may be susceptible to overturning in the wind, sandbags should be used for ballasting. Sandbags may be placed on lower parts of the frame or stays to provide the required ballast but shall not be placed on top of any striped rail.

Where maintenance activities are being performed, a street or highway condition is seldom of a character that will require a complete closing of the facility. When such a condition does occur, it is almost always an emergency situation, as would result from a broken water main or a washed-out culvert, for example. Repair work is generally initiated on an emergency basis and the street or road closing generally is of a kind wherein Type I is used.

On construction projects, when a road section is closed to traffic, Type III barricades shall be erected at the points of closure. They may extend completely across a roadway and its shoulders or from curb to curb. Where provision must be made for access of equipment and authorized vehicles, the Type III barricades should be provided with gates or movable sections that can be closed when work is not in progress, or with indirect openings that will discourage public entry. Where access is provided through the Type III barricades, responsibility should be assigned to a person to assure proper closure at the end of each working day.

When a road or street is legally closed, but access must still be allowed for local traffic, the Type III barricade cannot be erected completely across a roadway. Instead, an arrangement should be devised that will permit local use but effectively discourage use by through traffic. A sign with the appropriate legend concerning permissible use by local traffic shall be installed. Applications of this principle are illustrated in figures 6-3 and 6-4 (pages 6B-5 and 6B-6).

Wing barricades are a special application of Type III barricades, erected on the roadway shoulder (on one or both sides of the pavement) to give the illusion of a narrowed or restricted roadway. In advance of a construction or maintenance area, even where no part of the roadway is actually closed, wing barricades serve a useful purpose in alerting the driver. If used in a series, they should start at the outer edge of the shoulder and be brought progressively closer to the pavement. Wing barricades may be used as a mounting for the advance warning or guide signs or lighting devices. During periods of inactivity, a foldaway type of design may be advantageous. Examples of wing barricades are shown in figure 6-11.

Signs may be erected on barricades, particularly those of the fixed type, and they offer a most advantageous facility for this purpose. The ROAD CLOSED and Detour Arrow signs, and the Large Arrow warning signs, for example, can effectively be mounted on or above the barricade that closes the roadway.

Construction and maintenance zones often encroach into sidewalks or crosswalks necessitating provisions for alternate routing. Where it is not possible to close a path and divert the pedestrians to other walkways, barricades may be used to define the path. Flashers should be used on sidewalk barricades in accordance with the following paragraph however, where high levels of illumination exist for sidewalk areas the use of flashers on barricades may not be needed.

For nighttime use, it is desirable to add flashing warning lights when barricades are used singly and steady burn lights when barricades are used in a series for channelization.

6C-10 Portable Barrier—Design and Application

Barriers are highway appurtenances designed to prevent vehicular penetration from the travelway to areas behind the barrier such as to minimize damage to impacting vehicles and their occupants. They may also be used to separate two-way traffic.

Portable barriers are barriers that are capable of being moved from one site to another. These devices may be constructed of concrete, metal, or any material that will act to physically deter access of vehicles from certain portions of the right-of-way.

Barriers may serve an additional function of channelizing traffic; however, their use should be determined by engineering analysis and the protective requirements of the location, not the channelizing needs. When serving the additional function of channelizing traffic, portable barriers should be of a light color for increased visibility. For nighttime use, barriers shall be supplemented by the use of standard delineation or channelization markings or devices.

Barricade warning lights may be installed on continuous barriers. On each side of the roadway only the first two yellow warning lights at the start of a continuous barrier may be Type A flashing. Subsequent warning lights on the barrier shall be Type C yellow steady burning for channelization.

The effect of impacting the ends of barriers should be mitigated. Such mitigating measures include the use of crash cushions or flaring the ends of barriers away from the travelway.

D. MARKINGS

6D-1 Paving Markings Applications

When construction work necessitates the utilization of vehicle paths other than the lanes normally used, daytime and nighttime drive-through checks should be made to evaluate the path and the possibility that the pavement markings might inadvertently lead drivers from the intended path. Markings no longer applicable which might create confusion in the minds of vehicle operators shall be removed or obliterated as soon as practicable. Ideally, inappropriate existing pavement markings should be removed and the new delineation placed before opening the affected lane or lanes to traffic. Traffic shifts from one path to another should not be attempted unless there is sufficient time, equipment, materials and personnel available to properly complete it before the end of the workday.

Conflicting pavement markings must be obliterated to prevent confusion to vehicle operators. Proper pavement marking obliteration leaves a minimum of pavement scars and completely removes old pavement paint. Painting over existing stripes is not considered to meet the requirements for removal or obliteration. The intended vehicle path should be clearly defined during day, night, and twilight periods under both wet and dry pavement conditions.

Where stage construction requires changes in barricades or channelization, similar day-night checks and evaluations of the existing pavement marking should accompany each change. When temporary roadway is constructed to bypass a closed portion of highway, appropriate reflectorized pavement markings shall be placed on the approach to, and throughout the length of hard-surfaced temporary roadways. At locations where the duration of the temporary roadway is relatively short, pavement markings consisting of reflectorized paint lines may not be practical due to the time required and expense involved in their removal.

Under the above conditions, adequate short-term expendable pavement markings can be provided by use of pressure sensitive traffic marking tape or raised pavement markers. Either of these types of devices can be applied simply and quickly and can be removed with little or no difficulty when changing traffic patterns make the installation obsolete.

Temporary pavement markings shall be used in combination with appropriate warning signs, channelizing devices and delineation to clearly indicate the required vehicle paths.

Where maintenance activities are being performed, the use of pavement markings generally has little application. Normal maintenance work is considered to be that type of work which would be accomplished within one or more continuous work shifts with the work site being protected by an adequate complement of warning signs, flagmen and channelizing devices to indicate the proper vehicle path. Longer term maintenance work should, for the purpose of traffic handling through the work site, be treated as a "construction" project.

6D-2 Delineators

Delineation in construction and maintenance zones is intended to be a guide to indicate the alignment of the roadway and outlines the required vehicle path through these areas. Delineators are not to be used as a warning device.

Delineators are reflector units capable of clearly reflecting light under normal atmospheric condition from a distance of 1000 feet when illuminated by the upper beam of standard automobile lights. Reflective elements for delineators shall have a minimum dimension of approximately 3 inches.

Delineator applications in construction or maintenance areas, should always be made in combination with some of the other traffic control devices discussed in Part VI-C.

Delineators, when used, shall be mounted on suitable supports so that the reflecting unit is about 4 feet above the near roadway edge. The standard color for delineators used along the right side of streets and highways shall be white. The color of delineators used along the left edge of divided streets and highways and one-way roadways shall be yellow. Spacing along roadway curves should be such that several delineators are always visible to the driver.

6B. APPLICATION

6B-1 Traffic Control Zones

When traffic is affected by construction, maintenance, utility, or similar operations, traffic control is needed to safely guide and protect motorists, pedestrians, and workers in a *traffic control zone*. The traffic control zone is the distance between the first advance warning sign and the point beyond the work area where traffic is no longer affected.

Most traffic control zones can be divided into the following parts:

- Advance Warning Area,
- Transition Area,
- Buffer Space,
- Work Area, and
- Termination Area.

If no lane or shoulder closure is involved, the transition area will not be used. In this chapter, each of the "Parts" will be examined for one direction of travel. If the work activity affects more than one direction of travel, the same principles apply to traffic in all directions.

Figure 6-1 illustrates the five parts of a traffic control zone to be discussed in this section. The devices used in these areas, for different types and locations of work, are compared in Table 6-1.

Advance Warning Area

An advance warning area is necessary for all traffic control zones because drivers need to know what to expect. Before reaching the work area, drivers should have enough time to alter their driving patterns. The advance warning area may vary from a series of signs starting a mile in advance of the work area to a single sign or flashing lights on a vehicle.

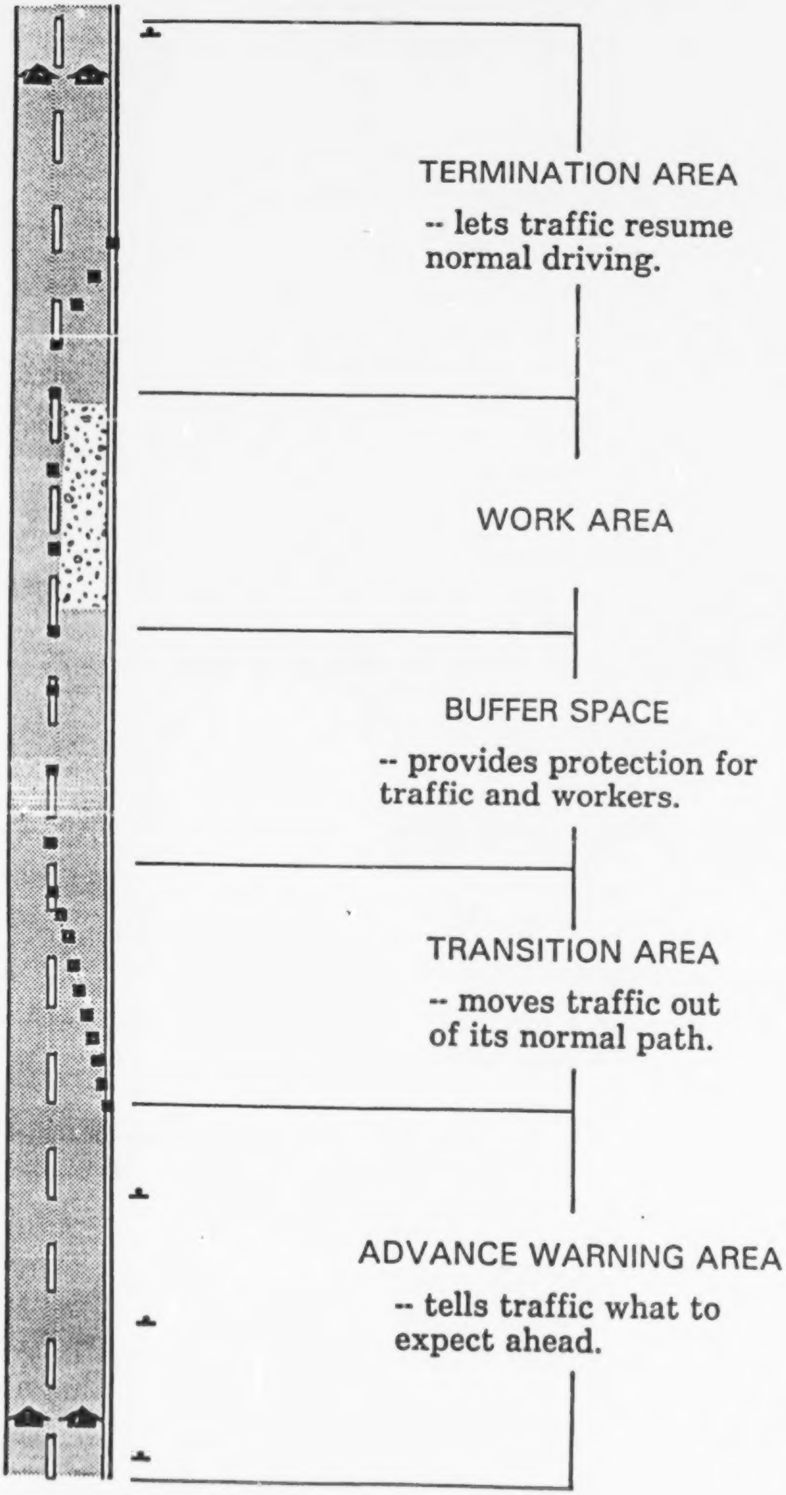
Advance warning signs may not be needed when the work area, including access to the work area, is entirely off the shoulder and the work does not interfere with traffic. An advance warning sign should be used when any problems or conflicts with the flow of traffic might possibly occur.

Length of the Advance Warning Area

The advance warning area, from the first sign to the start of the next area, should be long enough to give the motorists adequate time to respond to the conditions. For most operations, the length can be:

- One-half mile to one mile for freeways or expressways,
- 1,500 feet for most other roadways or open highway conditions,
- at least one block for urban streets.

For more specific applications, refer to Figures 6-9 through 6-32.



TERMINATION AREA

-- lets traffic resume normal driving.

WORK AREA

BUFFER SPACE

-- provides protection for traffic and workers.

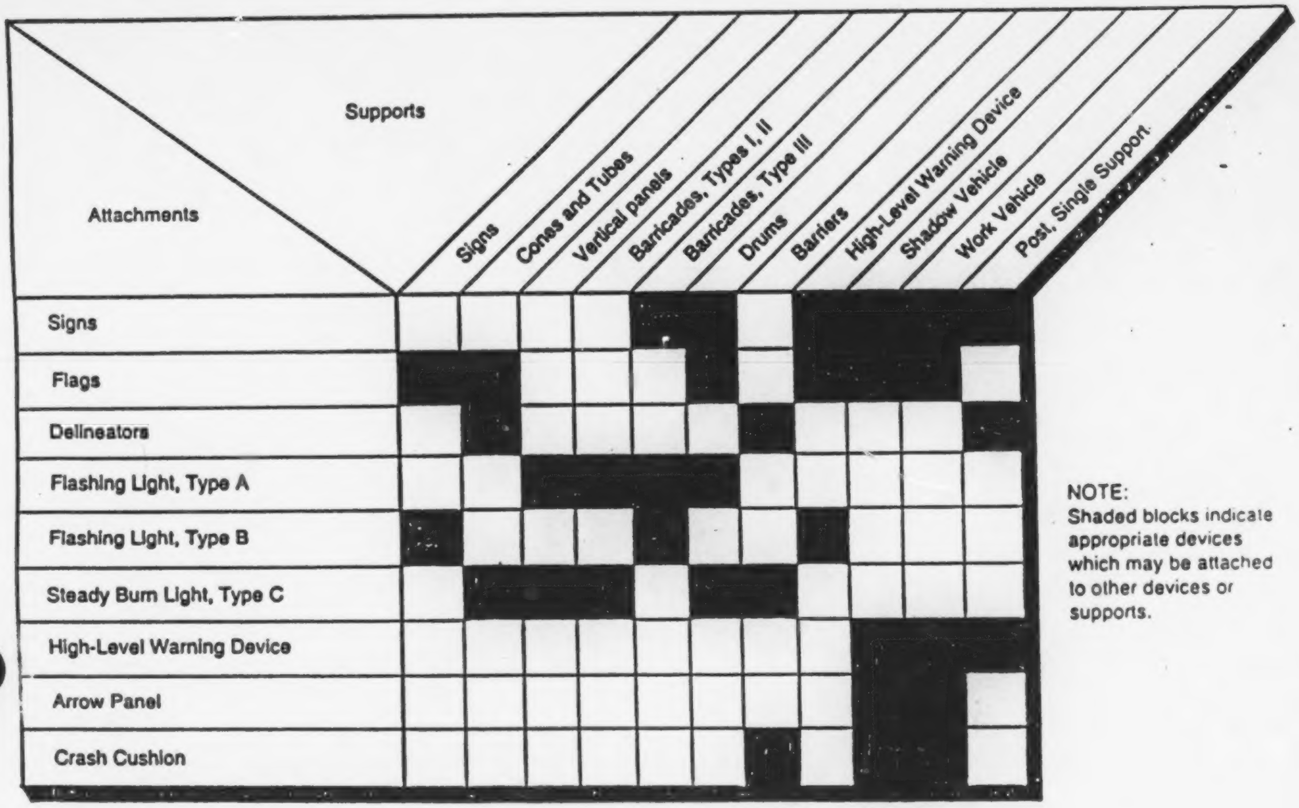
TRANSITION AREA

-- moves traffic out of its normal path.

ADVANCE WARNING AREA

-- tells traffic what to expect ahead.

Figure 6-1 Areas in a Traffic Control Zone



Attachments \ Supports	Signs	Cones and Tubes	Vertical panels	Barricades, Types I, II	Barricades, Type III	Drums	Barriers	High-Level Warning Device	Shadow Vehicle	Work Vehicle	Post, Single Support.
Signs					▨	▨		▨	▨	▨	▨
Flags	▨	▨				▨		▨	▨	▨	
Delineators		▨					▨				▨
Flashing Light, Type A			▨	▨	▨	▨					
Flashing Light, Type B	▨				▨			▨			
Steady Burn Light, Type C		▨	▨	▨		▨	▨				
High-Level Warning Device									▨	▨	▨
Arrow Panel									▨	▨	
Crash Cushion							▨		▨	▨	

NOTE:
Shaded blocks indicate appropriate devices which may be attached to other devices or supports.

Figure 4-1. Signs and devices that may be mounted on or used in combination with other devices.

Work Location	Road work ahead	Keep right	One lane road	Flagger	Right (or left) lane closed	Right (or left) two lanes closed	Merge right (left)	Signs on both sides of roadway	Taper in shoulder	Taper length L**	Flagger	Flashing arrow panel	Buffer space	Warning devices in front of work area	Barriers if work involves excavation***	Flashing lights and flags on vehicles are suggested	Channelizing devices along work area	Channelizing devices along center line	End work area	Downstream taper
Entirely beyond shoulder (or curb), no access from shoulder needed.															●	●				
Entirely beyond shoulder (or curb) with access from shoulder.	●														●	●			●	
On or over shoulder (or parking lane).	●								●				●		●	●	●		●	
On shoulder (or parking lane) with minor encroachment into traveled lane.	●	●							●				●	●	●	●	●		●	
One lane of a 2-lane, 2-way roadway	●		●	●						●	●		●	●	●	●	●		●	●
Right lane of a 4-lane, 2-way roadway.	●				●		●			●			●	●	●	●	●	●	●	●
Left lane of a 4-lane, 2-way roadway.	●				●		●			●			●	●	●	●	●	●	●	●
Two right lanes of a 4-lane, 2-way roadway. (Left lanes are similar.)	●				●		●			●			●	●	●	●	●		●	●
Right lane of a 2-lane, 1-way or divided roadway. (Left lane is similar.)	●				●		●	●		●			●	●	●	●	●		●	●
Two right lanes of a 4-lane, 1-way roadway. (Left lanes are similar.)	●					●	●	●		●		●	●	●	●	●	●		●	●
Work Location	Advance Warning Area*								Transition Area				Buffer Space		Work Area				Termination Area	

*A consistent pattern of messages is shown in this figure. Refer to MUTCD for other acceptable messages or symbol signs.
**Old pavement markings should be removed and new markings placed in transition area for longer-term activities.
***The use of barriers is determined by an engineering analysis of the need for positive protection.

Figure 5-1. Traffic Control Devices for various locations of work

Transition Area

When work is performed within one or more traveled lanes, a lane closure(s) is required. In the transition area, traffic is channelized from the normal highway lanes to the path required to move traffic around the work area. The transition area contains the tapers which are used to close lanes.

The transition area should be obvious to drivers. The correct path should be clearly marked with channelizing devices and pavement markings so drivers will not make a mistake and follow the old path. Existing pavement markings need to be removed when they conflict with the transition. New markings should be added. Pavement marking arrows are useful in transition areas.

With moving operations, the transition area moves with the work area. A shadow vehicle may be used to warn and guide traffic into the proper lane. Refer to section 6B-3, Shadow Vehicles, for additional guidance.

Tapers

A taper is a series of channelizing devices and pavement markings placed on an angle to move traffic out of its normal path. An example of a taper is shown in Figure 6-1.

Four general types of tapers used in traffic control zones are:

- Lane closure tapers are those necessary for closing lanes of moving traffic (sometimes referred to as channelizing tapers).
- Two-way traffic tapers are those needed to control two-way traffic where traffic is required to alternately use a single lane (commonly used when flaggers are present).
- Shoulder closure tapers are those needed to close shoulder areas.
- Downstream tapers are those installed to direct traffic back into its normal path.

Lane Closure Taper

The length of taper used to close a lane is determined by the speed of traffic and the width of the lane to be closed (the lateral distance that traffic is shifted). There are two formulas for determining the length of a taper (L) used for lane closures as discussed in Section 6C-2 of the MUTCD. The formulas and their criteria for application are shown in Table 6-2. If restricted sight distance is a problem (e.g., a sharp vertical or horizontal curve), the taper should begin well in advance of the view obstruction. The beginning of tapers should not be hidden behind curves. Table 6-3 shows the taper lengths, the recommended number, and the spacing of channelizing devices for various speeds and widths of closing.

Generally, tapers should be lengthened, not shortened, to increase their effectiveness. Traffic should be observed to see if the taper is working correctly. Frequent use of brakes and evidence of skid marks is an indication that either the taper is too short or the advance warning is inadequate. Section 6B–4 includes several typical applications which illustrate how tapers may be placed in urban areas in the vicinity of intersections.

FORMULAS FOR TAPER LENGTH	
Posted Speed	*Formula*
40 mph or under	$L = \frac{WS^2}{60}$
45 mph or over	$L = WS$

where: L =taper length
W =width of lane or offset
S =posted speed, or off-peak 85 percentile speed

Table 6-2. Formulas for taper length

Speed Limit M.P.H.	*Taper Length*			*Number of Channelizing Devices for Taper**	*Spacing of Devices Along Taper in Feet*
	Lane Width in Feet				
	10	*11*	*12*		
20	70	75	80	5	20
25	105	115	125	6	25
30	150	165	180	7	30
35	205	225	245	8	35
40	270	295	320	9	40
45	450	495	540	13	45
50	500	550	600	13	50
55	550	605	660	13	55

Table 6-3. Taper Lengths for Lane Closures—Distance L

*** Based on 12-foot wide lane. This column is appropriate for lane widths less than 12 feet.**

Two-Way Traffic Taper

The two-way traffic taper is used in advance of a work area that occupies part of a two-way road in such a way that the remainder of the road is used alternately by traffic in either direction. In this situation, the function of the taper is not to cause traffic to merge, but rather to resolve the potential head-on conflict. A short taper is used to cause traffic to slow down by giving the appearance of restricted alignment. Drivers then have time at reduced speed to decide whether to proceed cautiously past the work space or to wait for opposing traffic to clear. One or more flaggers are usually employed to assign the right-of-way in such situations.

Two-way traffic tapers should be 50 to 100 feet long, with channelizing devices spaced a maximum of 10 to 20 feet, respectively, to provide clear delineation of the taper. Flashing arrows boards (in the arrow mode) should never be used with a two-way traffic taper.

Shoulder Closure Taper

When an improved shoulder is closed on a high-speed roadway, it should be treated as a closure of a portion of the roadway because motorists expect to be able to use the shoulder in the event of an emergency. The work area on the shoulder should be preceded by a taper that may be shorter than for lane closures. One-half of the length from Table 6-3 is suggested as a maximum for shoulder closure tapers, provided the shoulder is not used as a travel lane. If the shoulder is being used as a travel lane, either through practice of through use caused by construction, a lane closure taper should be placed on the shoulder.

Downstream Taper

A downstream taper is used at the downstream end of the work area to indicate to drivers that they can move back into the lane that was closed. It is placed in the termination area. While closing tapers are optional, they may be useful in smoothing traffic flow. They may not be advisable when material trucks move into the work area by backing up from the downstream end of the work area.

Closing tapers are similar in length and spacing to two-way traffic tapers.

Buffer Space

The buffer space is the open or unoccupied space between the transition and work areas (Figure 6-1). With a moving operation, the buffer space is the space between the shadow vehicle, if one is used, and the work vehicle.

The buffer space provides a margin of safety for both traffic and workers. If a driver does not see the advance warning of fails to negotiate the transition, a buffer space provides room to stop before the work area.

It is important for the buffer space to be free of equipment, workers, materials, and workers' vehicles. When designing or setting out a Traffic Control Plan the following guidelines should be considered for buffer spaces:

- Place channelizing devices along the edge of the buffer space. The suggested spacing in feet is equal to two times the posted speed limit.
- Situations occur where opposing streams of traffic are transitioned so one lane of traffic uses a lane that normally flows in the opposite direction. In these situations, a buffer space should be used to separate the two tapers for opposing directions of traffic because it could help prevent head-on collisions. See Figure 6-12 for an example of this type of buffer space.

Work Area

The work area is that portion of the roadway which contains the work activity and is closed to traffic and set aside for exclusive use by workers, equipment, and construction materials. Work areas may remain in fixed locations or may move as work progresses. An empty buffer space may be included at the upstream end. The work area is usually delineated by channelizing devices or shielded by barriers to exclude traffic and pedestrians.

Conflicts and Potential Hazards

Conflicts between traffic and the work activity are potential hazards. These increase as:

- The work area is closer to the traveled lanes;
- Physical deterrents to normal operation exist; such as uneven pavements, vehicles loading or unloading;
- Speed and volume of traffic increase; and
- The change in travel path gets more complex, shifting traffic a few feet in comparison with shifting traffic across the median and into lanes normally used by opposing traffic.

Work areas that remain overnight have a greater need for delineation than daytime operations.

Every feasible effort should be made to minimize conflicts. Some suggestions include:

- Use traffic control devices to make the travel path clearly visible to traffic.
- Place channelizing devices between the work area and the traveled way. Section 6C-2 of the MUTCD states that devices placed on a tangent (along the work area) to keep traffic out of a closed lane should be spaced in accordance with the extent and type of activity,

the speed limit of the roadway, and the vertical and horizontal alignment such that it is apparent that the lane is closed. The MUTCD does not specify a spacing for the devices along the closed lane. For high-speed roadways, a range from 2S to 4S (two to four times the posted speed limit) is suggested. For low-speed or urban streets, a closer spacing may be used.

- Provide a safe entrance and exit for work vehicles.
- Protect mobile and moving operations with adequate warning on the work and/or shadow vehicles.
- Flags and flashing lights should be considered on work vehicles exposed to traffic.

Termination Area

The termination area provides a short distance for traffic to clear the work area and to return to the normal traffic lanes. It extends from the downstream end of the work area to the END CONSTRUCTION or END ROAD WORK sign. A downstream taper may be placed in the termination area.

For some work operations, such as single location utility or maintenance repair, it may not be necessary to display a sign as it will be obvious to drivers that they have passed the work area.

There are occasions where the termination area could include a transition. For example, if a taper were used to shift traffic into opposing lanes around the work area, then the termination area should have a taper to shift traffic back to its normal path. This taper would then be in the transition area for the opposing direction of traffic. It is advisable to use a buffer space between the tapers for opposing traffic, as shown in Figure 6-12.

Avoid "gaps" in the traffic control that may falsely indicate to drivers that they have passed the work area. For example, if the work area includes intermittent activity throughout a 1-mile section, the drivers should be reminded periodically that they are still in the work area. The primary purpose of the guide sign ROAD CONSTRUCTION NEXT— MILES is to inform the drivers of the length of the work area. It should not be erected until work begins.

6B-2 Planning for Traffic Control

During planning for work zones, one should strive for the greatest payoff in terms of safety and convenience at a cost commensurate with the hazards and problems involved. A properly installed traffic control zone will allow traffic to pass through or around a work zone safely. It requires time and effort for planning, installation, and maintenance. All employees involved with work-zone safety should be properly trained. These include design, traffic, and construction engineers, inspectors, superintendents, and foremen.

All work-zone traffic-control planning centers around an analysis of the work activity and relating it to the provision of adequate safety and capacity. What is the likelihood of motorists failing to negotiate the work zone safely? What are the consequences of such action on pedestrians, workers, or other motorists?

Planning for traffic control through a construction zone may be more involved than for maintenance or utility zones because of the differences in traffic disruption and duration of the work. Although the requirement for safety in all zones is the same, planning for the three types of work operations will be discussed separately. The exposure of traffic to potential hazards is a function of the traffic volume and the length of time that the closure will be in effect. The goals common to all traffic control zones are:

- to minimize accidents and accident severity; and
- to minimize inconvenience and conflicts as a result of the work. It should be recognized that these goals may at times be at odds.

Minimize Accidents

For all work zones, the first fundamental principle, according to Section 6A-5 of the MUTCD, is that safety should have a high priority through all stages of the work. The following list is a set of guidelines that may be helpful in achieving this goal:

- Use traffic control devices that are visible and effective.
- Follow the standards in the MUTCD on the use and location of tapers and transitions. Avoid introducing severely reduced travel path geometrics at the approaches to or within the work area.
- Minimize fixed object hazards. For example, use lightweight channelizing devices and use crash cushions to protect barrier ends. Sand bags should be placed on the bottom of supports for various devices so that they do not become a projectile as a result of a collision.
- Minimize traffic conflicts with workers and equipment. Consider using a portable barrier.
- Provide night visibility with illumination, reflectorized devices, warning lights, and pavement markings. Consider floodlighting hazardous areas. However, care should be taken to insure that the floodlights are not aimed in a way that would adversely affect motorist's vision.
- Provide safe pedestrian walkways by separating pedestrians from vehicular traffic and work activities. Provide safe pedestrian and vehicular access across or through driveways.

- Store equipment and materials outside the clear recovery zone as defined in the Guide for Selecting, Locating, and Designing Traffic Barriers (Ref. 6-3).
- Provide a buffer space between traffic and workers.
- Provide safe employee access to work, storage areas, businesses, residences, and within the work area. Provide a safe entrance and exit for work vehicles. This may require the use of temporary traffic signals, flaggers, or temporary portable barriers.
- Plan for the safety of workers on the project as required by safety and health regulations. (e.g., safety clothing, hardhats, etc.)
- Flags and flashing lights should be utilized on work vehicles exposed to traffic. To protect mobile and moving operations, shadow vehicles may be used and equipped with signs, flags, flashing lights, and/or crash cushions as appropriate.

Minimize Inconvenience

Work in or near traveled lanes often causes confusion and disruption of normal traffic. The traffic control plan should be aimed at reducing inconvenience and conflicts, as stated above and in Section 6A-5, Principle 2, of the MUTCD. The following list is a set of guidelines that may be helpful in achieving this goal:

- Close only those lanes that must be closed, and reopen them as soon as practicable to maintain maximum roadway capacity.
- Avoid severe speed reductions.
- Avoid traffic delays that could cause backups.
- Avoid scheduling work during peak hours and holidays.
- Prepare an alternate route or plan in case of an accident or other emergency. If an alternate route is not feasible, be prepared to use signs, flaggers, and radio announcements to warn traffic of the backup and to explain the delay.
- Reduce inconveniences for pedestrians and bicyclists by providing the shortest and safest path, safe clearances, and minimum grades, steps, and curbs.
- Emergency organizations, such as police, fire, and ambulance services, should be notified prior to the start of work. This will allow them to adjust their routes and/or work schedules accordingly.
- Emergency vehicles should have a high priority in passing through a work zone or using an alternate route.
- Access to police and fire stations, fire hydrants, and hospitals should be maintained at all times.

Utility Work Zones

Utility work may be divided into three classifications, emergency, maintenance, and new construction. The guidelines for traffic control listed here are for normal situations and additional protection should [illegible] provided when special complexities and hazards exist.

Emergency Work

- Can occur at any time of day or night;
- May be caused by storm damage;
- May involve disruptions of utility service to customers;
- Work operation usually involves a small crew and a work vehicle [illegible] a short period of time;
- The work vehicle should be equipped with a yellow flashing [illegible] limited number of portable signs and channelizing devices in good condition, and equipment for flaggers in the event they are needed; and
- The extent of traffic control may be less than [illegible] construction or maintenance, yet the safety of [illegible] motorists, and workers should be provided.

Maintenance and New Construction for Utilities

The public will not easily make a distinction between maintenance and new construction so the type of traffic control used should be adequate for the nature, location, and duration of work, type of roadway, traffic volume and speed, and potential hazards. New construction and some maintenance activities are planned (as opposed to emergency activities) [illegible] the following guidelines should be considered:

- In urban areas, consider avoiding the hours of peak traffic [illegible] scheduling work.
- Maintain street and road work areas for only as long as is [illegible] to safely move in, finish the work, remove all utility work signs, and move out.
- Take special care to clearly mark suitable boundaries for the work space with channelizing devices so pedestrians and drivers can [illegible] the work space. If any of the traveled lanes are closed, tapers [illegible] used as required by the MUTCD. If a shoulder is closed, a shoulder taper is suggested.
- Pedestrians should not be expected to walk on a path which is inferior to the previous path. Loose dirt, mud, broken concrete, or steep slopes may force pedestrians to walk on the roadway rather than the sidewalk. Repairs (temporary or permanent) to damaged sidewalks should be made quickly. This may include bridging with steel plates or good quality wood supports.

BEST COPY AVAILABLE

- Any work which cannot be completed during the day and which impedes traffic or presents a hazard overnight may need additional attention. Reflectorized signs and channelizing devices are required by the MUTCD. Warning lights are optional but should be considered.
- Any member of the crew who serves as a flagger should be equipped with a red flag or a STOP-SLOW paddle, a reflective vest, and should be trained for proper flagging procedures.
- Work areas involving excavations on the roadway generally should not exceed the width of one traffic lane at a time. The work should be staged and, if needed, approved bridging should be utilized. This type of activity should be fully coordinated with the traffic or public works department having jurisdiction over the street or highway.

Highway Maintenance Work Zones

Maintenance operations are needed to preserve, repair, and restore the streets and highways and include those activities performed on travelway surfaces, shoulders, roadsides, drainage facilities, bridges, signs, markings, and signals.

These operations may be emergencies (as a result of storms or accidents), or planned activities. They may be stationary, mobile, or moving operations. The traffic control needed will vary according to the nature, location and duration of work, type of roadway and speed of traffic, and potential hazard.

Traffic Control Plans for Construction Projects

A formal Traffic Control Plan (TCP) is required to be included in the plans, specifications and estimates (PS&E) for all Federal-aid projects by Federal-Aid Highway Program Manual 6-4-2-12. (Ref. 6-4.) Other construction projects should also have a TCP, as indicated in Section 6A-3 of the MUTCD. These plans may range in scope from a very detailed TCP designed solely for a specific project, to a reference to standard plans, a section of the MUTCD, or a standard highway agency manual. The degree of detail in the TCP will depend on the complexity of the project and on the interaction of traffic needs and construction activities.

Highway agency design and traffic engineers will develop the TCP and include it in the PS&E. The contractor can develop a TCP, but may use it only if it is equal to or better than the TCP in the plans, and is approved by the highway agency.

BASIC TRAFFIC CONTROL GUIDELINES

Installation and removal activities can be more hazardous than those after installation because drivers are confronted with a new situation with only a partial traffic control layout, and workers must be in the roadway to place and remove traffic control devices.

Consider that a portion of the traffic stream consists of motorists who cannot function well (sleepy, drunk, poor eyesight, etc.).

Always use standard signs and traffic control devices.

Provide information sufficiently far in advance for motorists to react and respond, but not so much as to forget. For very long zones, periodic reminders may be needed.

Provide high-type design, warning far in advance, large highly visible control devices, and gradual channelization for high-speed conditions.

Use regulatory signs only when proper authority has been obtained to impose or alter regulations.

Provide for speed reductions in increments of 10 miles per our.

Make sure all messages presented on signs are accurate in describing the situation.

Mark location of devices to expedite their installation and maintenance when traffic control duration or reoccurrence warrants.

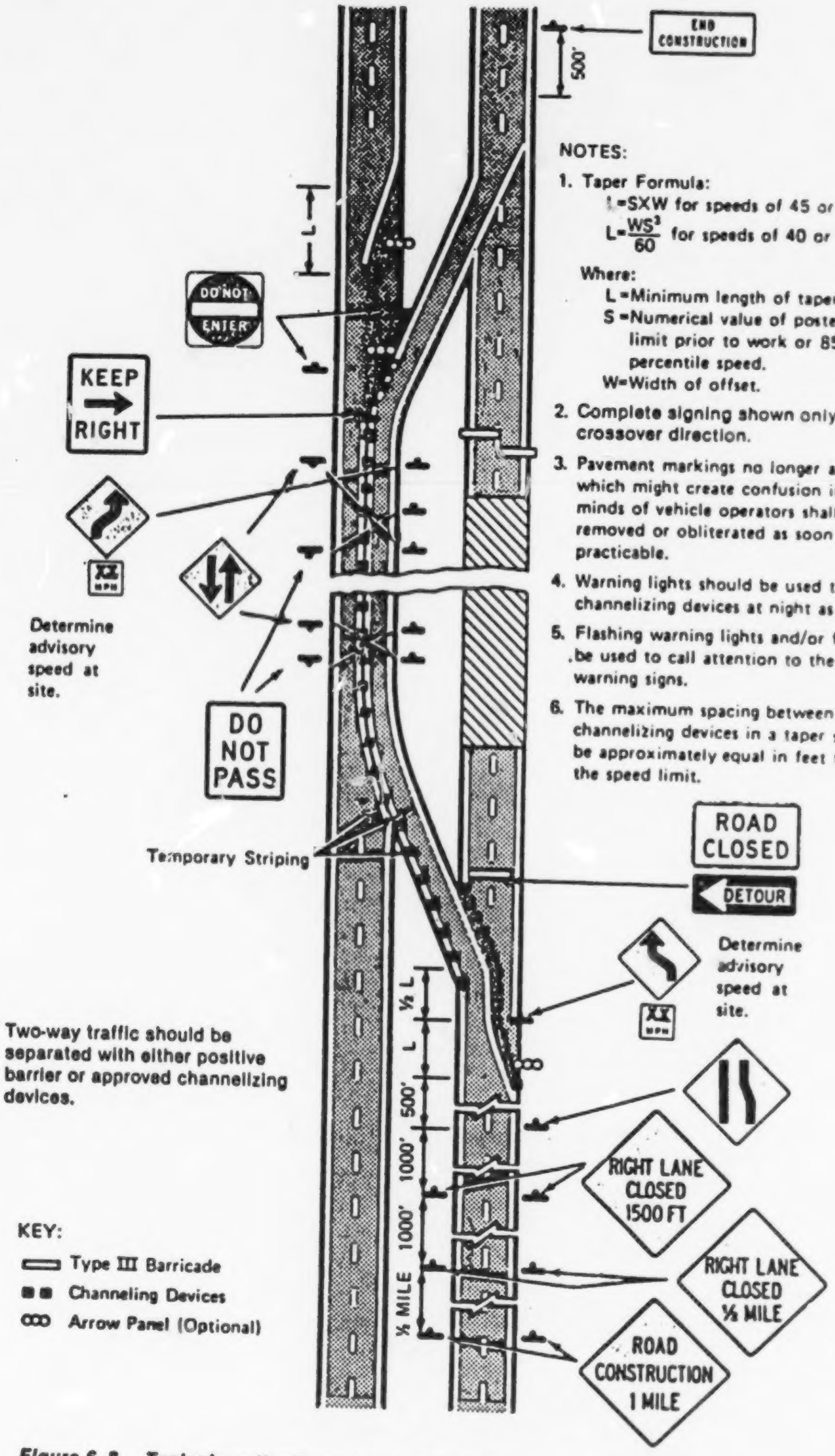
Always install devices in the order encountered by the motorists and remove in reverse order of the installation when possible.

Be alert for any unnecessary hazards within the traffic control zone; ie. workers private vehicles, material and equipment storage, or unprotected excavations.

When in doubt as to the adequacy of traffic controls, improvements are achieved through large signs, longer tapers, and more advanced warning.

Always remove or cover signs and other traffic control devices when the work area protection is not required.

Make sure that all devices that are needed for night operation are reflectorized, of proper height, and illuminated as necessary.


END CONSTRUCTION
500'
L
DO NOT ENTER
KEEP RIGHT
XX MPH
Determine advisory speed at site.
DO NOT PASS
Temporary Striping
ROAD CLOSED
DETOUR
Determine advisory speed at site.
XX MPH
½ L
L
500'
1000'
1000'
½ MILE
RIGHT LANE CLOSED 1500 FT
RIGHT LANE CLOSED ½ MILE
ROAD CONSTRUCTION 1 MILE

NOTES:

1. Taper Formula:
   L=SXW for speeds of 45 or more.
   $L=\frac{WS^2}{60}$ for speeds of 40 or less.

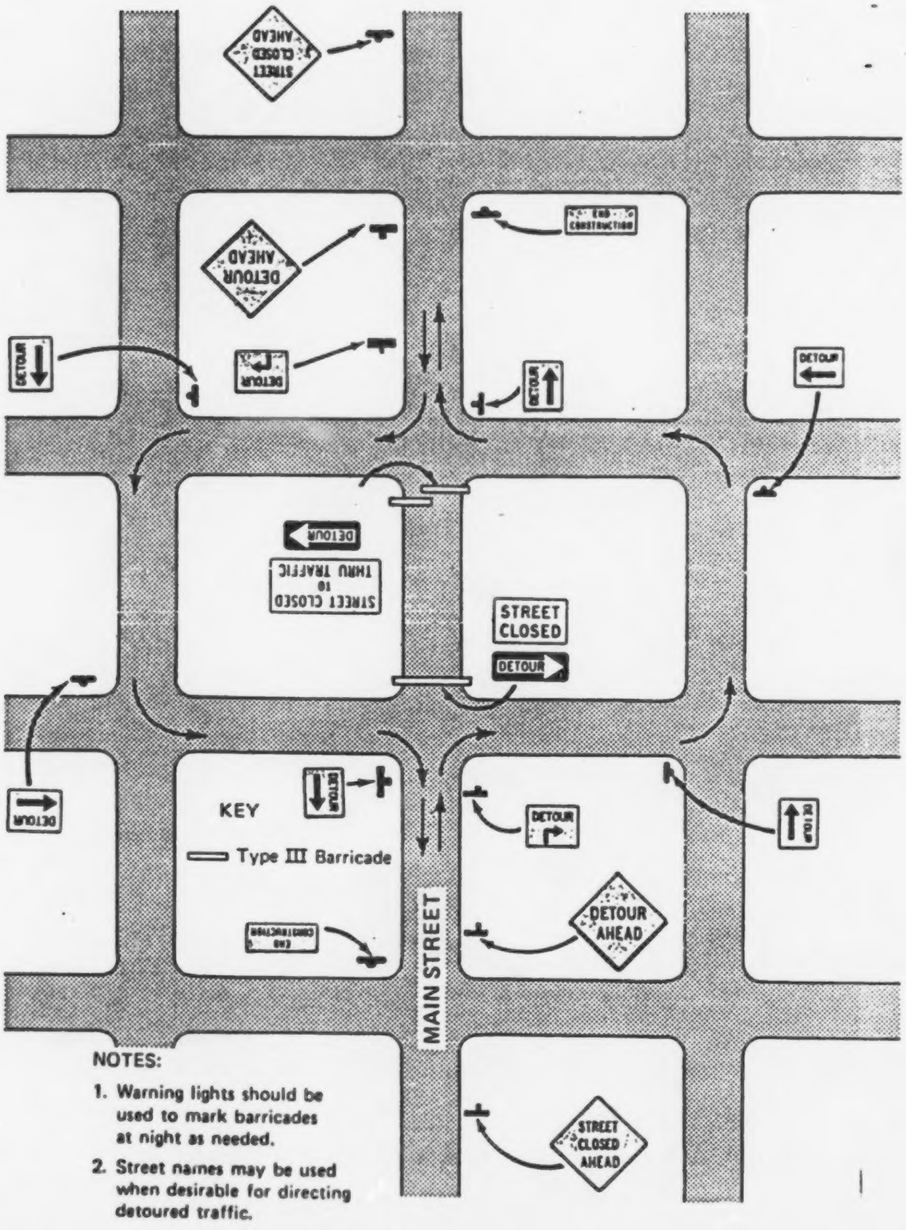
   Where:
   L=Minimum length of taper.
   S=Numerical value of posted speed limit prior to work or 85 percentile speed.
   W=Width of offset.
2. Complete signing shown only in the crossover direction.
3. Pavement markings no longer applicable which might create confusion in the minds of vehicle operators shall be removed or obliterated as soon practicable.
4. Warning lights should be used to mark channelizing devices at night as needed.
5. Flashing warning lights and/or flags may be used to call attention to the early warning signs.
6. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.

Two-way traffic should be separated with either positive barrier or approved channelizing devices.

KEY:

▭ Type III Barricade
■■ Channeling Devices
○○○ Arrow Panel (Optional)

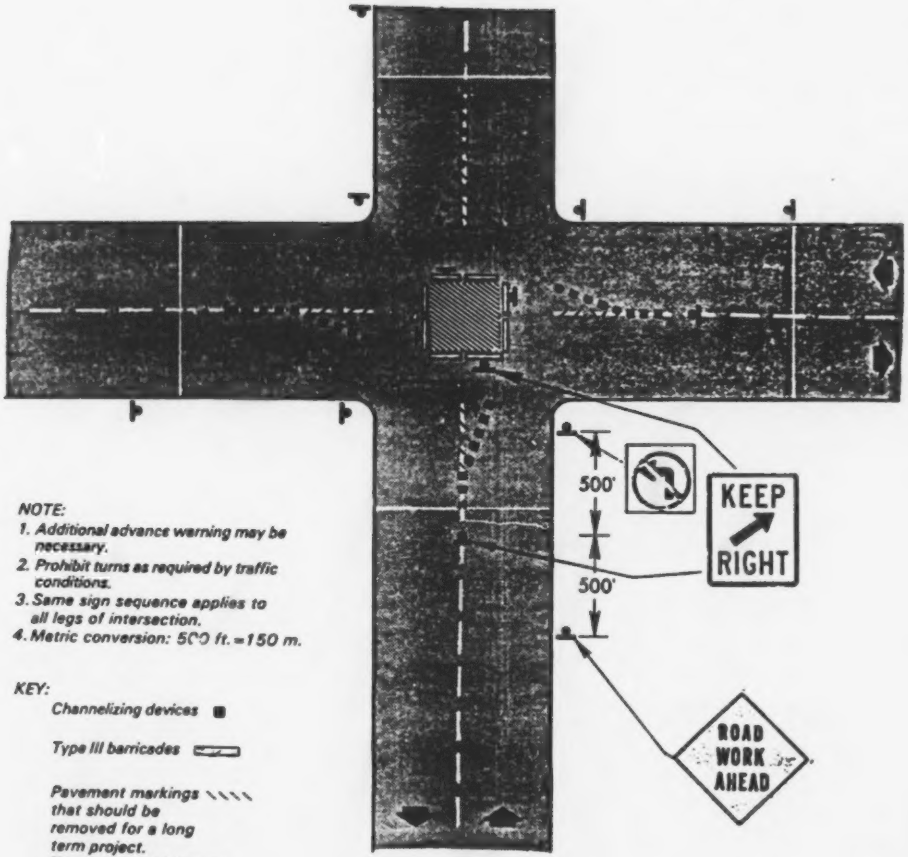
Figure 6-8. Typical application—4-lane divided roadway where one roadway is closed.


STREET CLOSED AHEAD
DETOUR AHEAD
END CONSTRUCTION
DETOUR
DETOUR
DETOUR
DETOUR
DETOUR
STREET CLOSED TO THRU TRAFFIC
STREET CLOSED
DETOUR
DETOUR
KEY
Type III Barricade
DETOUR
DETOUR
DETOUR
DETOUR AHEAD
END CONSTRUCTION
MAIN STREET
STREET CLOSED AHEAD

NOTES:

1. Warning lights should be used to mark barricades at night as needed.
2. Street names may be used when desirable for directing detoured traffic.

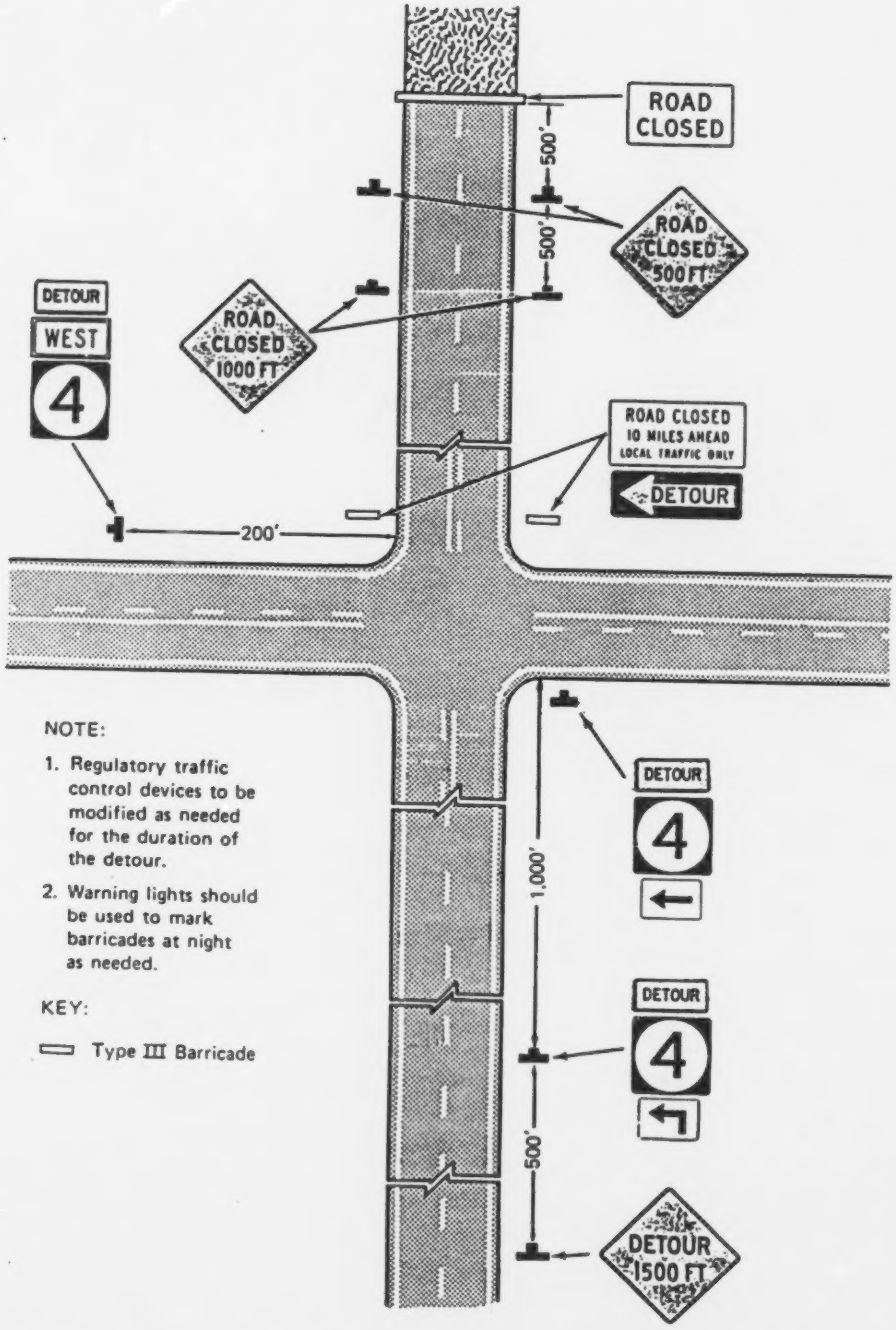
Figure 6-4. Typical application—detour signing for street construction project in a street grid.



NOTE:
1. *Additional advance warning may be necessary.*
2. *Prohibit turns as required by traffic conditions.*
3. *Same sign sequence applies to all legs of intersection.*
4. *Metric conversion: 500 ft. = 150 m.*

KEY:
Channelizing devices ■
Type III barricades ▭
Pavement markings that should be removed for a long term project. Temporary markings to be placed as needed. \\\\

Figure 6-28 Typical Application of Traffic Control Devices when the Work Area Is in the Center of an Intersection


ROAD CLOSED
500'
500'
ROAD CLOSED 500 FT
DETOUR
WEST
4
ROAD CLOSED 1000 FT
ROAD CLOSED
10 MILES AHEAD
LOCAL TRAFFIC ONLY
DETOUR
200'
DETOUR
4
1,000'
DETOUR
4
500'
DETOUR 1500 FT

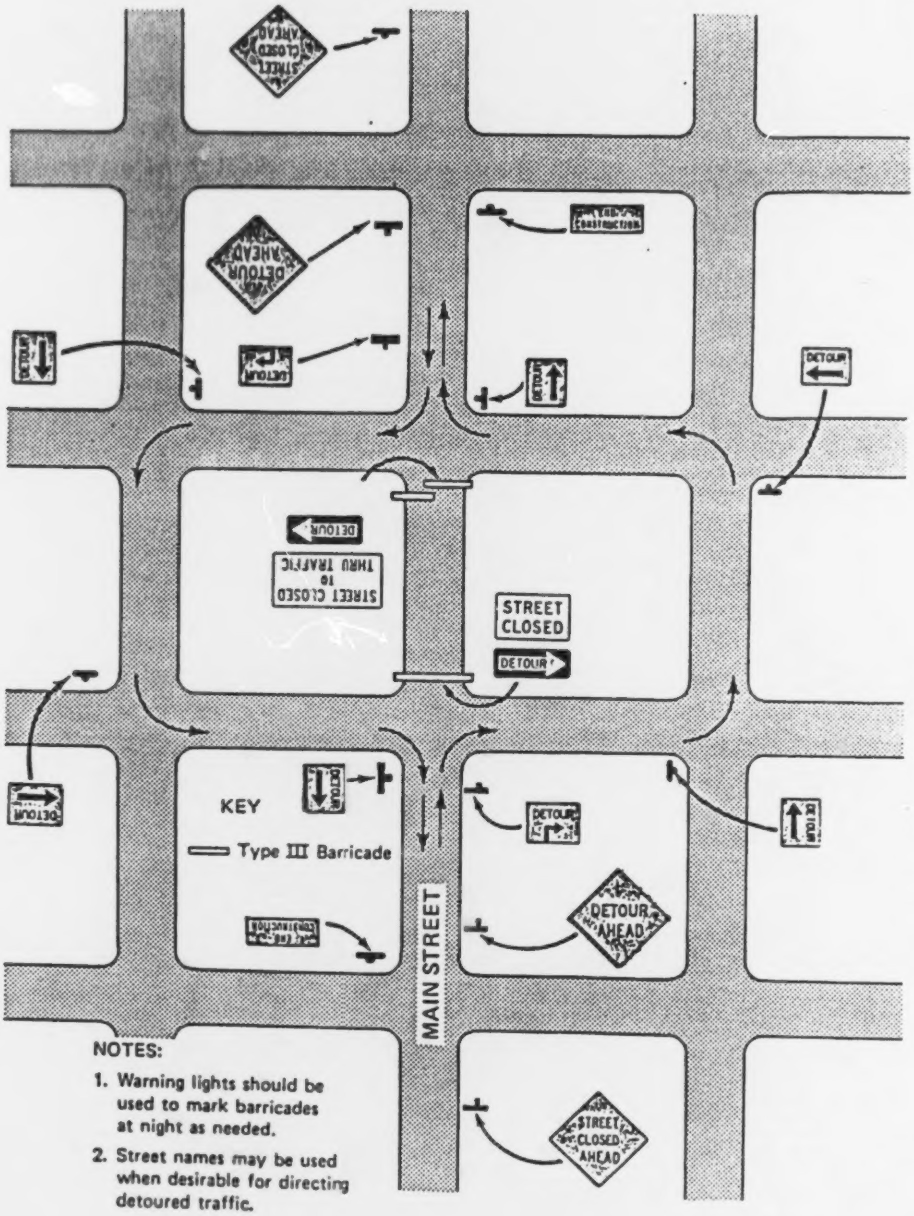
NOTE:

1. Regulatory traffic control devices to be modified as needed for the duration of the detour.
2. Warning lights should be used to mark barricades at night as needed.

KEY:

▭ Type III Barricade

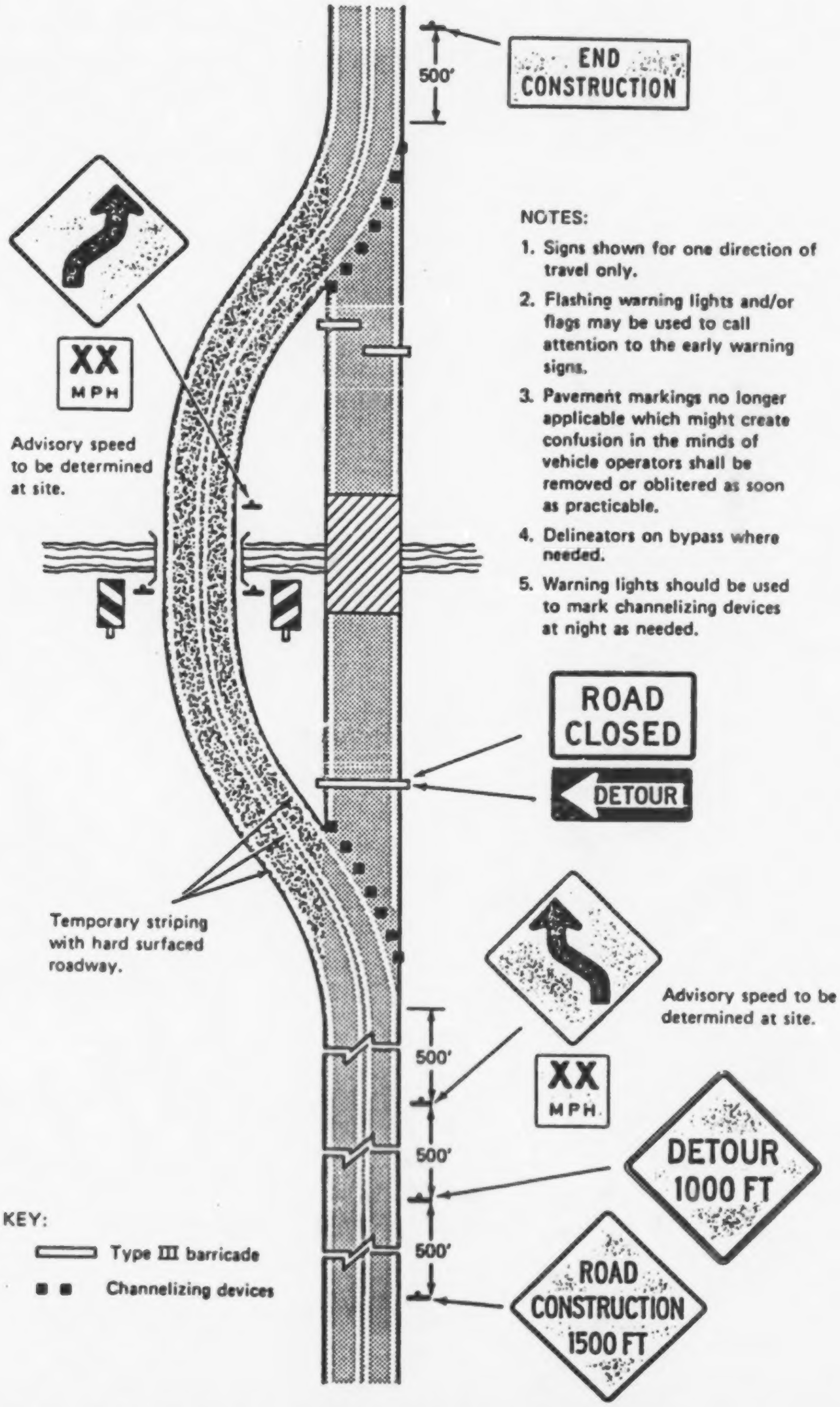
Figure 6-29 Typical Application—Roadway Closed Beyond Detour Point (MUTCD, Figure 6-3)


STREET CLOSED AHEAD
DETOUR AHEAD
DETOUR
STREET CLOSED TO THRU TRAFFIC
STREET CLOSED
KEY
Type III Barricade
MAIN STREET

NOTES:

1. Warning lights should be used to mark barricades at night as needed.
2. Street names may be used when desirable for directing detoured traffic.

Figure 6-30 Typical Application—Detour Signing for Street Construction Project in a Street Grid (MUTCD, Figure 6-4)


END CONSTRUCTION
500'
XX
MPH
ROAD CLOSED
DETOUR
XX
MPH
500'
500'
DETOUR 1000 FT
500'
ROAD CONSTRUCTION 1500 FT

NOTES:

1. Signs shown for one direction of travel only.
2. Flashing warning lights and/or flags may be used to call attention to the early warning signs.
3. Pavement markings no longer applicable which might create confusion in the minds of vehicle operators shall be removed or oblitered as soon as practicable.
4. Delineators on bypass where needed.
5. Warning lights should be used to mark channelizing devices at night as needed.

Advisory speed to be determined at site.

Temporary striping with hard surfaced roadway.

Advisory speed to be determined at site.

KEY:

▭ Type III barricade

■ ■ Channelizing devices

Figure 6-31 Typical Applications of Traffic Control Devices on a Two-lane Highway Where the Entire Roadway Is Closed and a Bypass Detour Is Provided (MUTCD, Figure 6-2)

NOTES:

1. Taper Formula:
   $L = SXW$ for speeds of 45 or more.
   $L = \frac{WS^2}{60}$ for speeds of 40 or less.

   Where:
   L = Minimum length of taper.
   S = Numerical value of posted speed limit prior to work or 85 percentile speed.
   W = Width of offset.

2. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.

KEY:

■ ■ Channelizing devices

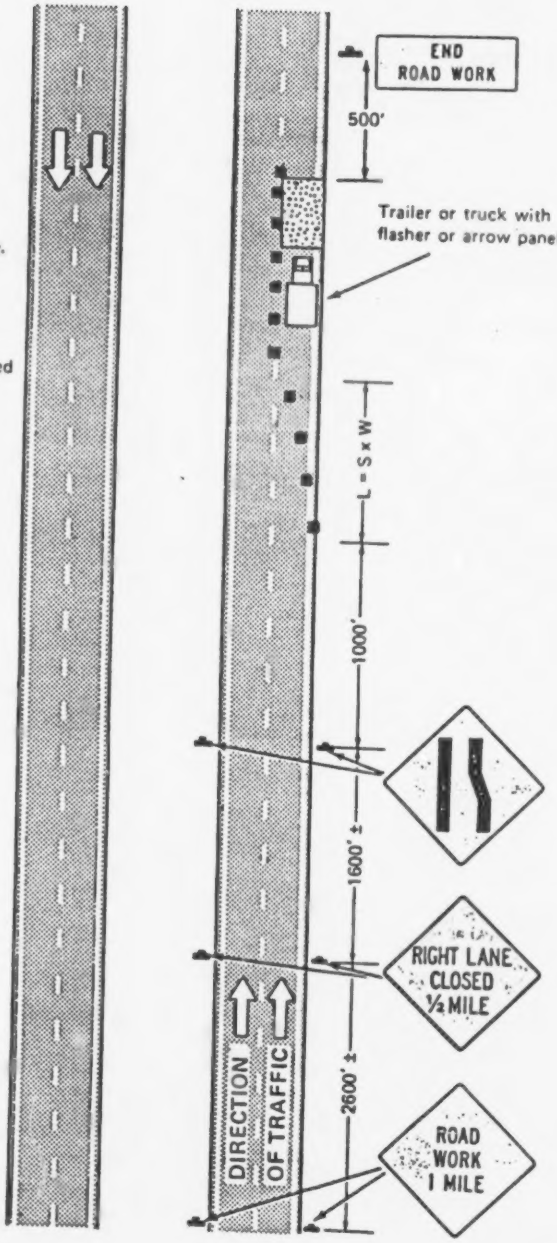
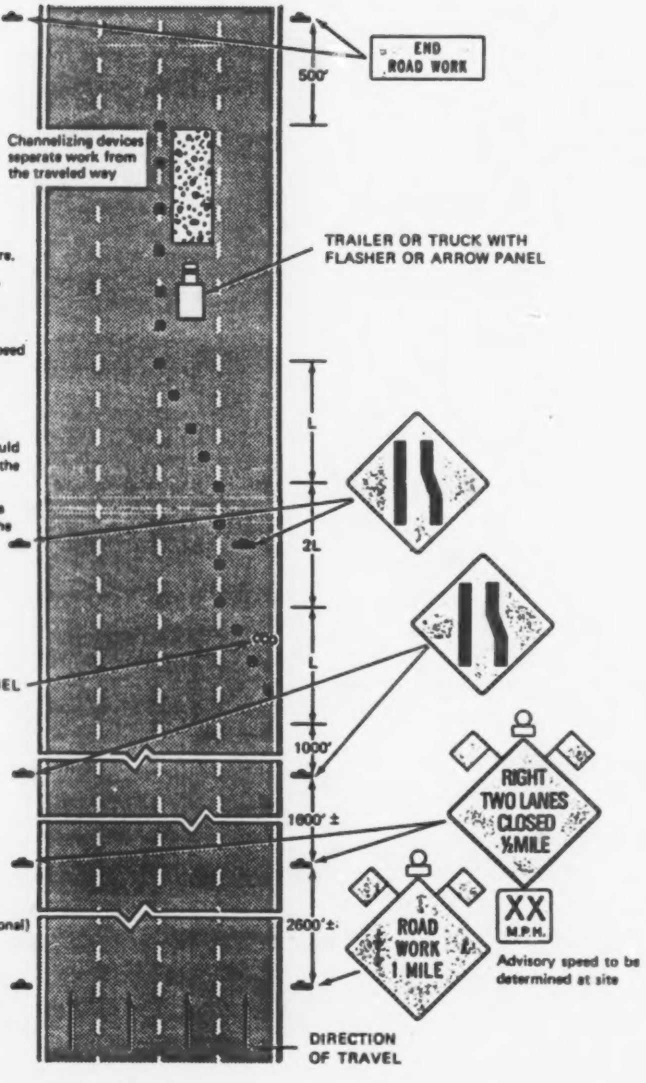

END
ROAD WORK
500'
Trailer or truck with flasher or arrow panel.
L = S x W
1000'
1600' ±
RIGHT LANE CLOSED ½ MILE
2600' ±
ROAD WORK 1 MILE
DIRECTION
OF TRAFFIC

Figure 6-15 Typical Application—Daytime Maintenance Operations of Short Duration on a Four-lane Divided Roadway Where One Lane is Closed (MUTCD, Figure 6-9)

NOTES:

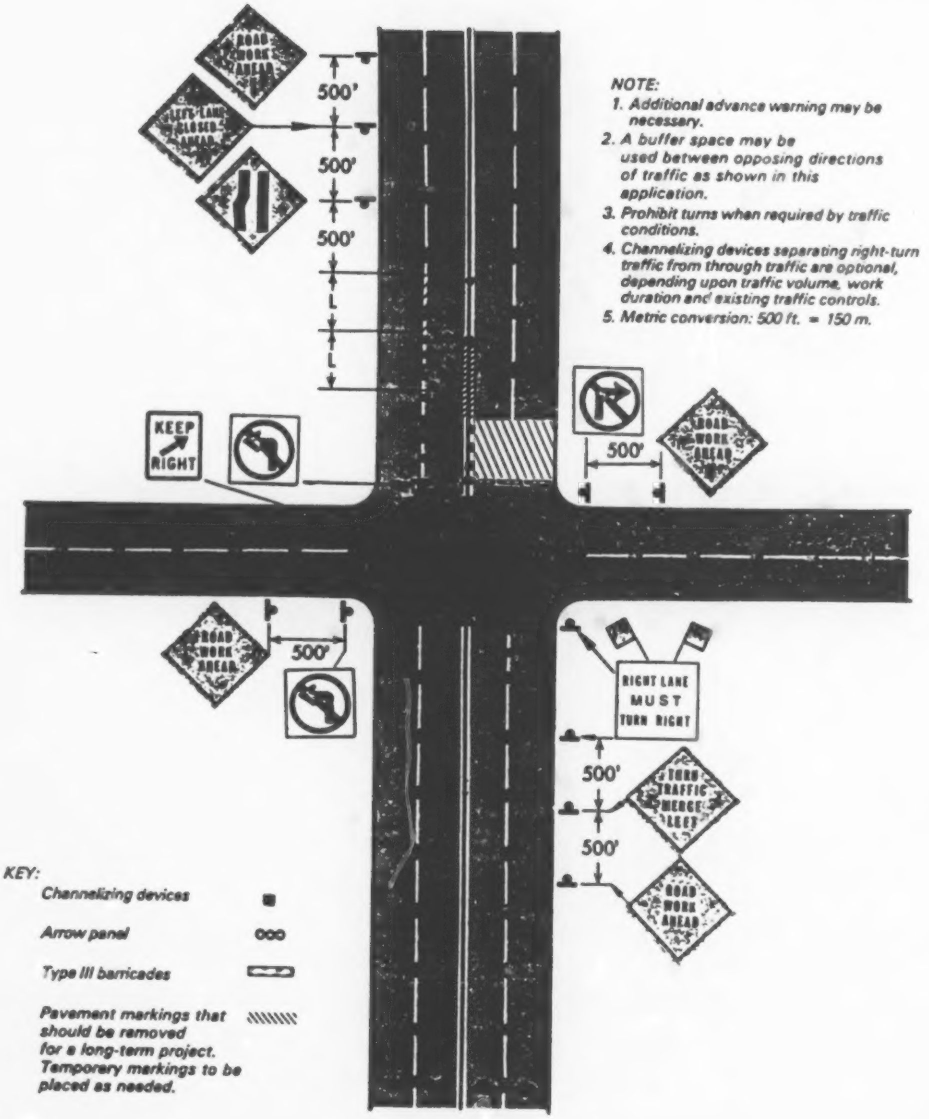
1. Taper Formula:
   $L = S \times W$ for speeds of 45 or more.
   $L = \frac{WS^2}{60}$ for speeds of 40 or less.

   Where:
   L = Minimum length of taper.
   S = Numerical value of posted speed limit prior to work or 85 percentile speed.
   W = Width of offset.
2. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.
3. Flashing warning lights and/or flags may be used to call attention to the early warning signs.


END ROAD WORK
500'
Channelizing devices separate work from the traveled way
TRAILER OR TRUCK WITH FLASHER OR ARROW PANEL
L
2L
L
ARROW PANEL
1000'
1600' ±
2600' ±
RIGHT TWO LANES CLOSED ½MILE
XX M.P.H.
ROAD WORK 1 MILE
Advisory speed to be determined at site
DIRECTION OF TRAVEL

KEY:
- ● ● Channelizing devices
- ooo Arrow Panel (Optional)
- Flashing Warning Light (Optional)

Figure 6-16 Typical Application—Closing Multiple Lanes of a Multi-lane Highway
(MUTCD, Figure 6-10)


ROAD WORK AHEAD
500'
LEFT LANE CLOSED AHEAD
500'
500'
L
L
KEEP RIGHT
500'
ROAD WORK AHEAD
ROAD WORK AHEAD
500'
RIGHT LANE MUST TURN RIGHT
500'
TURN TRAFFIC MERGE LEFT
500'
ROAD WORK AHEAD

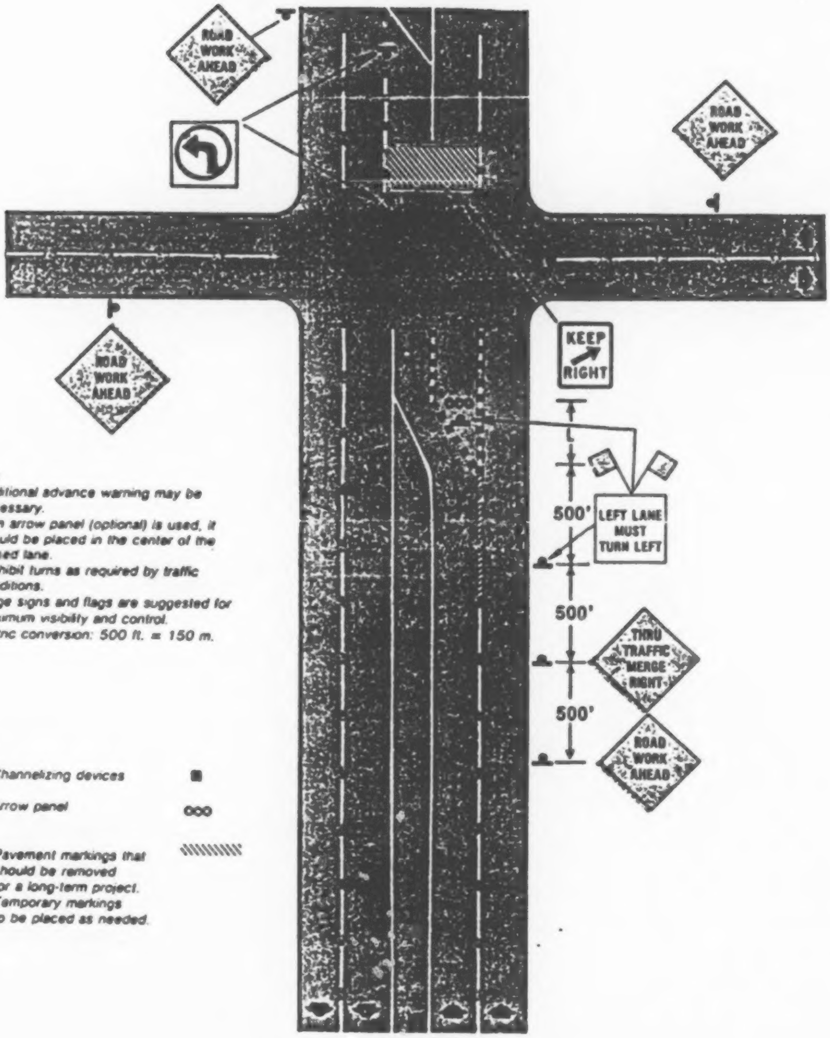
NOTE:

1. *Additional advance warning may be necessary.*
2. *A buffer space may be used between opposing directions of traffic as shown in this application.*
3. *Prohibit turns when required by traffic conditions.*
4. *Channelizing devices separating right-turn traffic from through traffic are optional, depending upon traffic volume, work duration and existing traffic controls.*
5. *Metric conversion: 500 ft. = 150 m.*

KEY:

Channelizing devices	■
Arrow panel	ooo
Type III barricades	▭
Pavement markings that should be removed for a long-term project. Temporary markings to be placed as needed.	▨

Figure 6-26 Typical Application of Control Around a Work Area Near an Intersection, Allowing Right Turns


ROAD WORK AHEAD
ROAD WORK AHEAD
ROAD WORK AHEAD
KEEP RIGHT
L
500'
LEFT LANE MUST TURN LEFT
500'
THRU TRAFFIC MERGE RIGHT
500'
ROAD WORK AHEAD

NOTE:

1. Additional advance warning may be necessary.
2. If an arrow panel (optional) is used, it should be placed in the center of the closed lane.
3. Prohibit turns as required by traffic conditions.
4. Large signs and flags are suggested for maximum visibility and control.
5. Metric conversion: 500 ft. = 150 m.

KEY:

Channelizing devices	■
Arrow panel	○○○
Pavement markings that should be removed for a long-term project. Temporary markings to be placed as needed.	▨

Figure 6-27 Typical Application of Traffic Control Devices Used for a Work Area Near an Intersection, Providing Access to Left-turn Lane

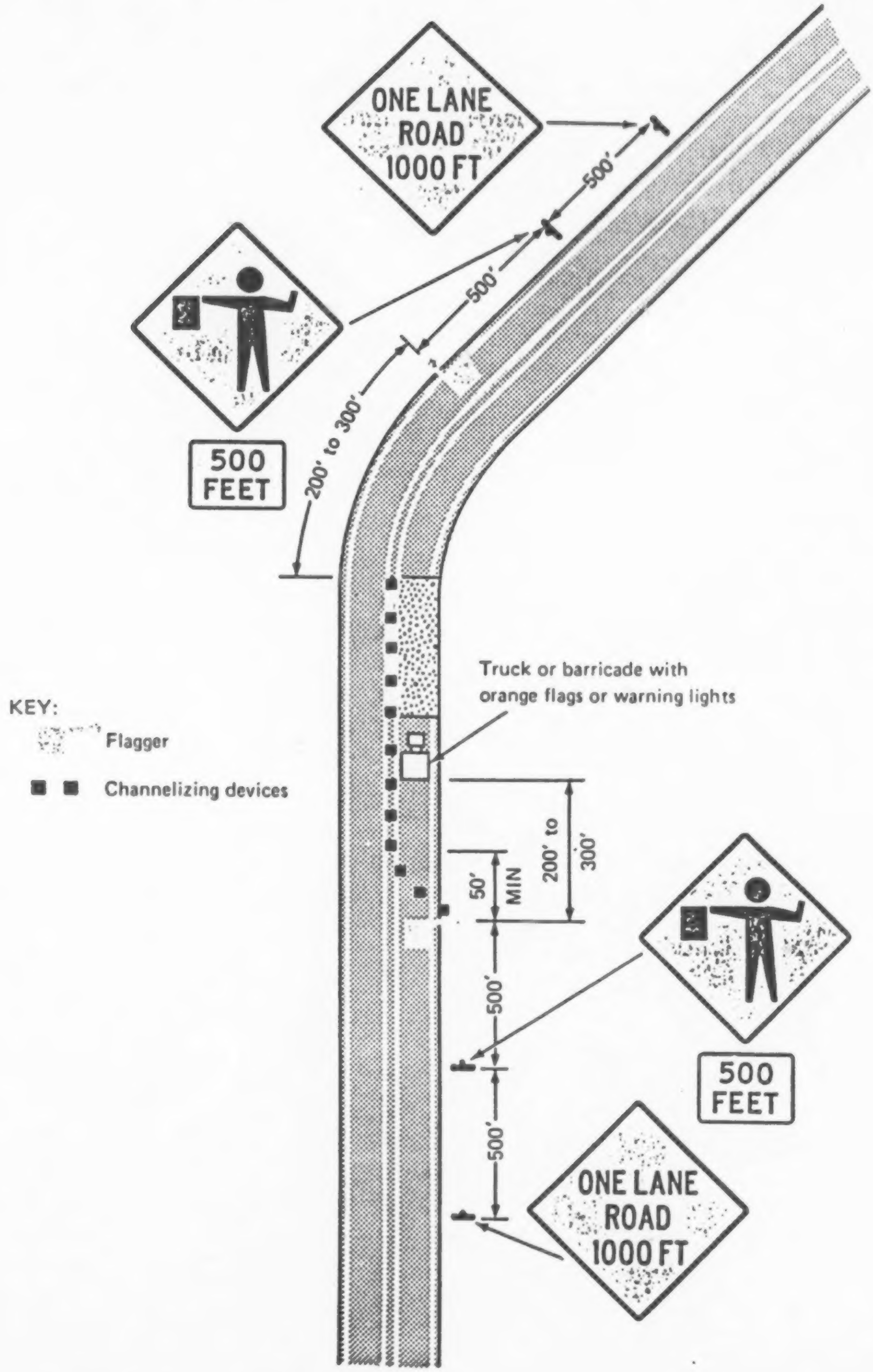
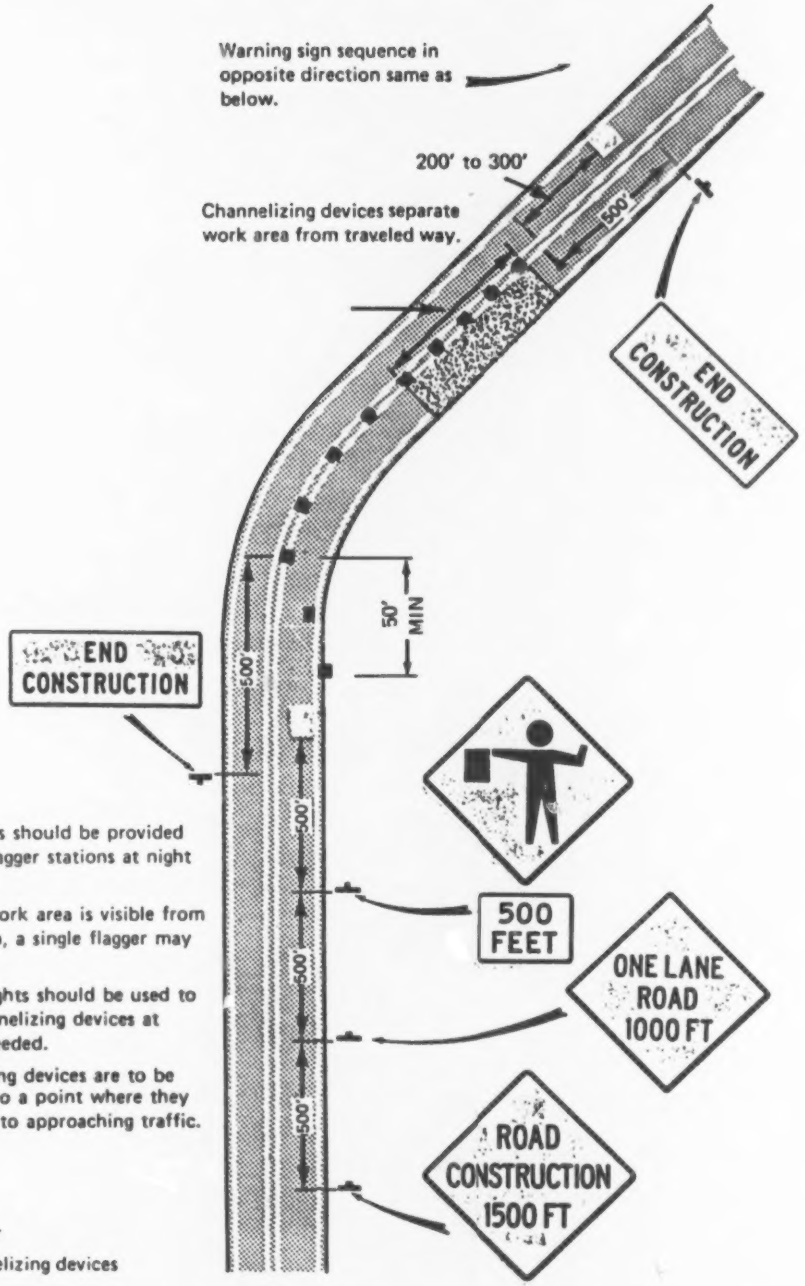

ONE LANE ROAD 1000 FT
500'
500'
500 FEET
200' to 300'
Truck or barricade with orange flags or warning lights
KEY:
Flagger
Channelizing devices
200' to 300'
50' MIN
500'
500 FEET
500'
ONE LANE ROAD 1000 FT

Figure 6-10 Typical Application—Daytime Maintenance Operations of Short Duration on a Two-lane Roadway and Flagging is provided (MUTCD, Figure 6-6)


Warning sign sequence in opposite direction same as below.
200' to 300'
Channelizing devices separate work area from traveled way.
500'
END CONSTRUCTION
50' MIN
500'
END CONSTRUCTION
500'
500 FEET
500'
ONE LANE ROAD 1000 FT
500'
ROAD CONSTRUCTION 1500 FT

Note:

1. Flood lights should be provided to mark flagger stations at night as needed.
2. If entire work area is visible from one station, a single flagger may be used.
3. Warning lights should be used to mark channelizing devices at night as needed.
4. Channelizing devices are to be extended to a point where they are visible to approaching traffic.

Key:

Flagger

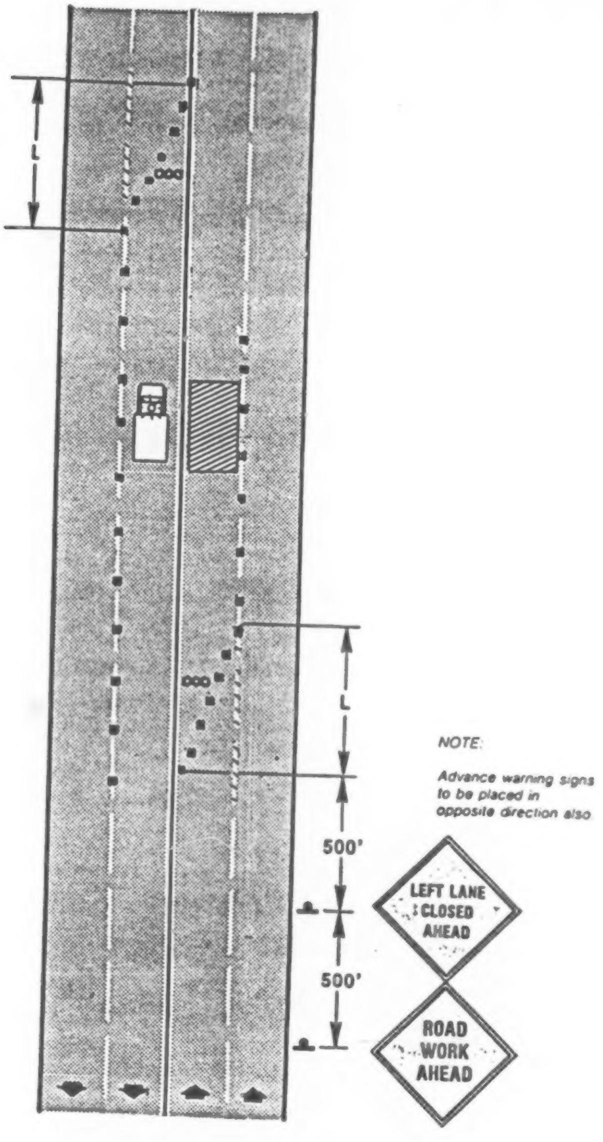
■ ■ Channelizing devices

Figure 6-11 Typical Application of Traffic Control Devices on a Two-lane Highway Where one Lane is Closed and Flagging is Provided (MUTCD, Figure 6-5)

NOTE:
1. Additional advance warning signs may be necessary.
2. A buffer space may be used.
3. The lane closure for opposing traffic is optional, depending on the need for access to the work space and protection of traffic.
4. Length of advance warning area shown is for urban streets. For rural or open highway conditions, the advance warning area should be at least 1500 ft. long.
5. Metric conversion: 500 ft. = 150 m.
6. L = length of taper — refer to Table 6-3.

KEY:

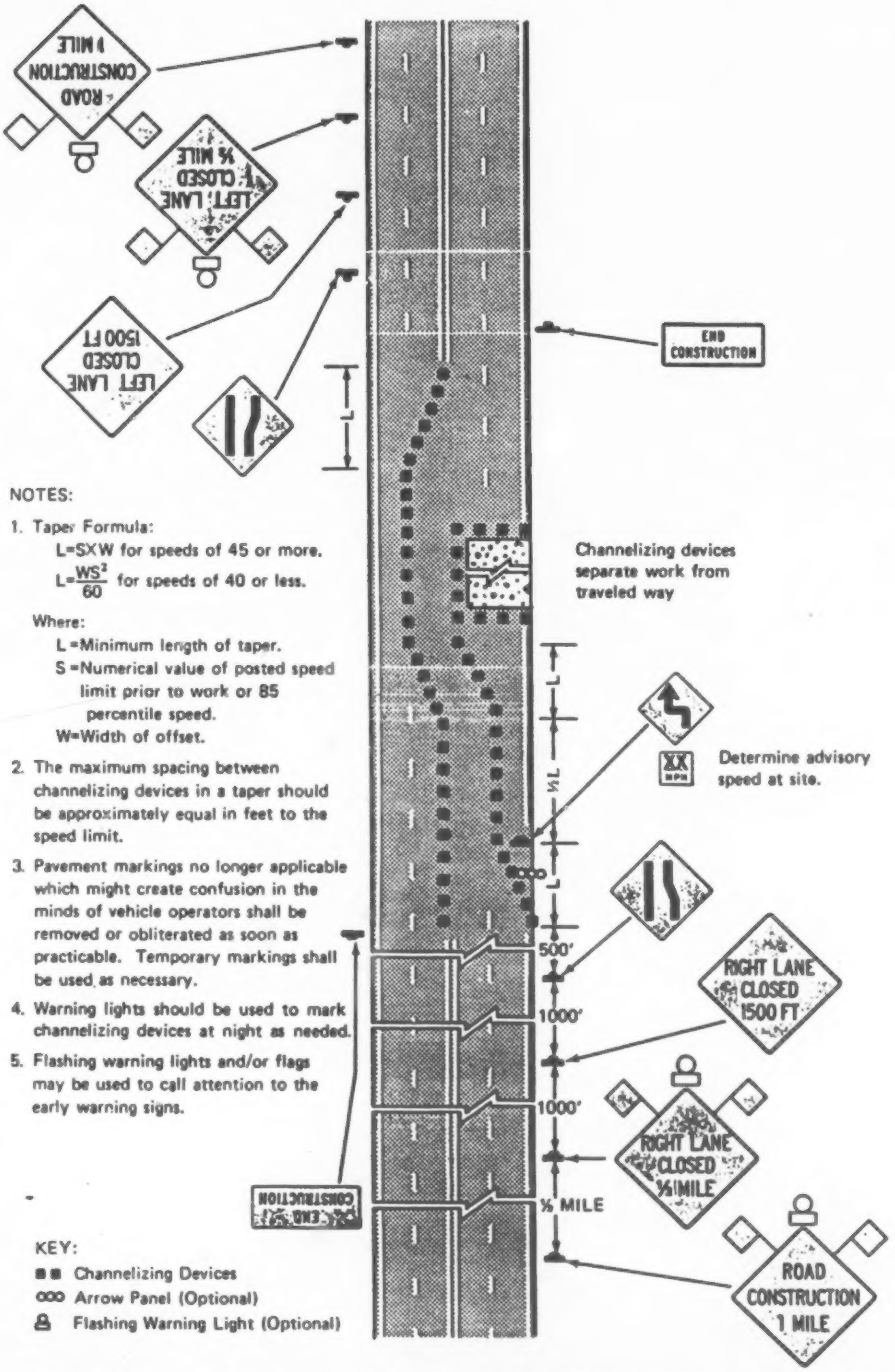
Channelizing devices	■
Arrow panel	ooo
Flashing vehicle light	☼
Pavement markings that should be removed for a long-term project. Temporary markings to be placed as needed.	//////



NOTE:

Advance warning signs to be placed in opposite direction also.

Figure 6-13 Typical Application—Work Area Within Left Lane, Allowing Access to Work Areas from Adjacent Lane


ROAD CONSTRUCTION 1 MILE
LEFT LANE CLOSED ½ MILE
LEFT LANE CLOSED 1500 FT
END CONSTRUCTION
L
Channelizing devices separate work from traveled way
L
½ L
L
XX MPH
Determine advisory speed at site.
500'
RIGHT LANE CLOSED 1500 FT
1000'
1000'
RIGHT LANE CLOSED ½ MILE
½ MILE
ROAD CONSTRUCTION 1 MILE
END CONSTRUCTION

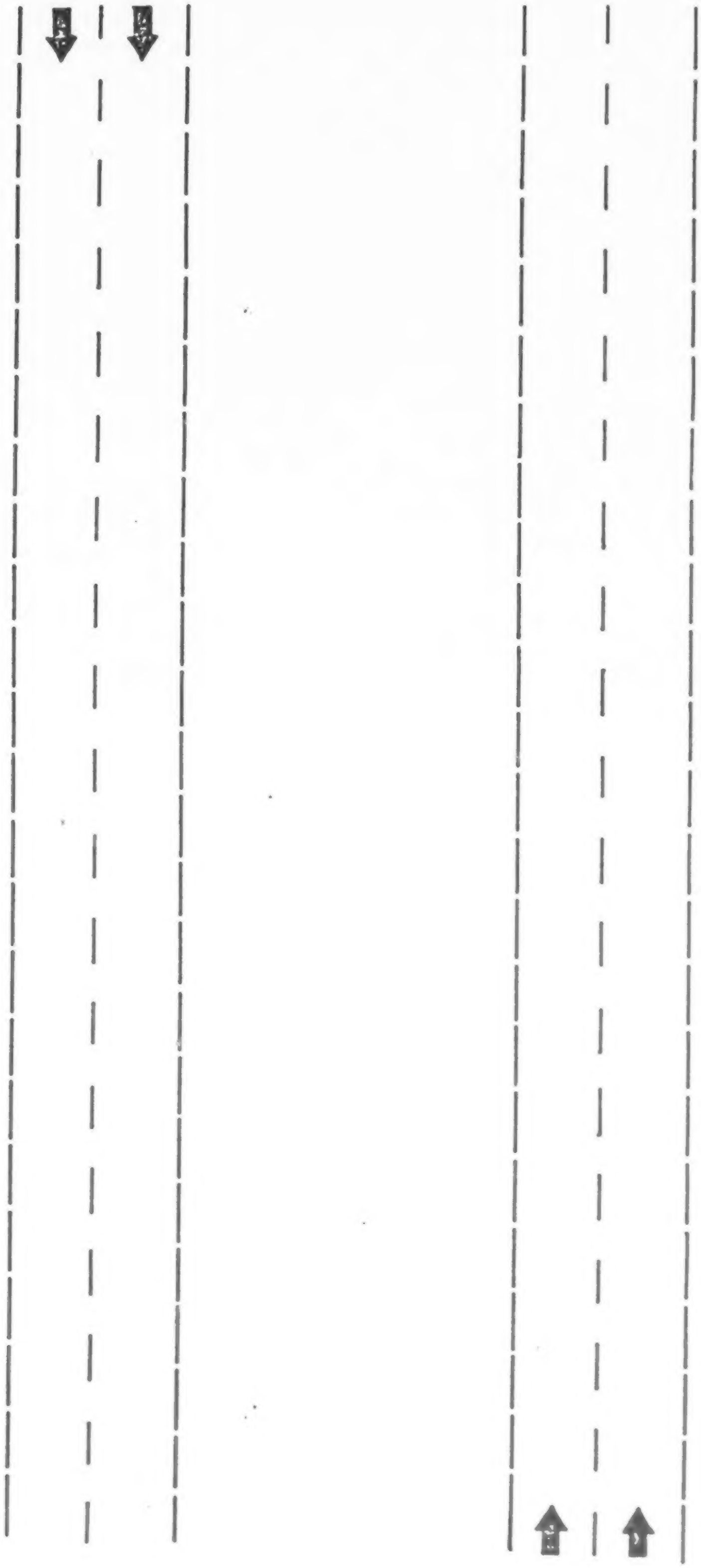
NOTES:

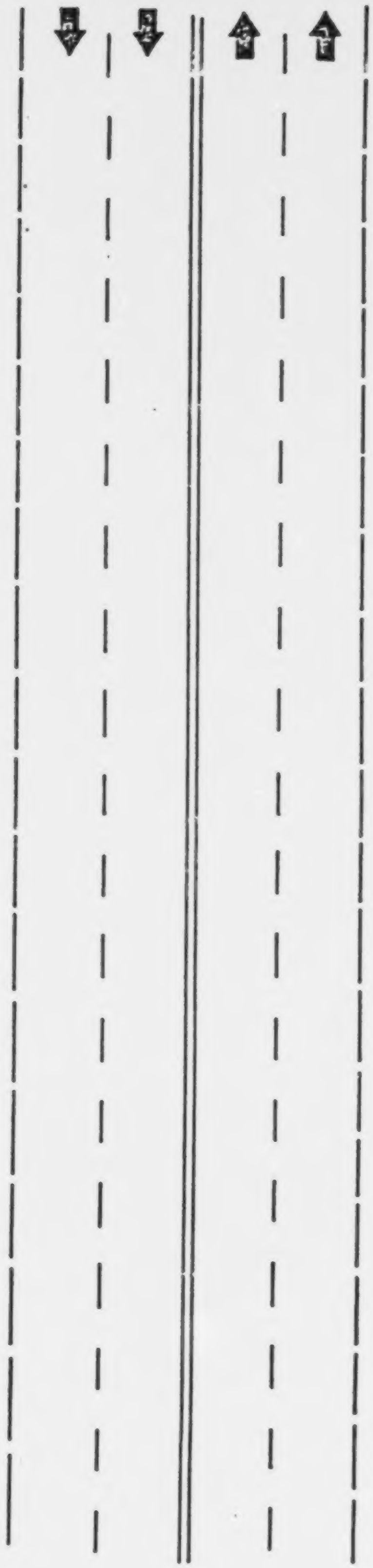
1. Taper Formula:
   L=SXW for speeds of 45 or more.
   $L=\frac{WS^2}{60}$ for speeds of 40 or less.
   Where:
   L=Minimum length of taper.
   S=Numerical value of posted speed limit prior to work or 85 percentile speed.
   W=Width of offset.
2. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.
3. Pavement markings no longer applicable which might create confusion in the minds of vehicle operators shall be removed or obliterated as soon as practicable. Temporary markings shall be used as necessary.
4. Warning lights should be used to mark channelizing devices at night as needed.
5. Flashing warning lights and/or flags may be used to call attention to the early warning signs.

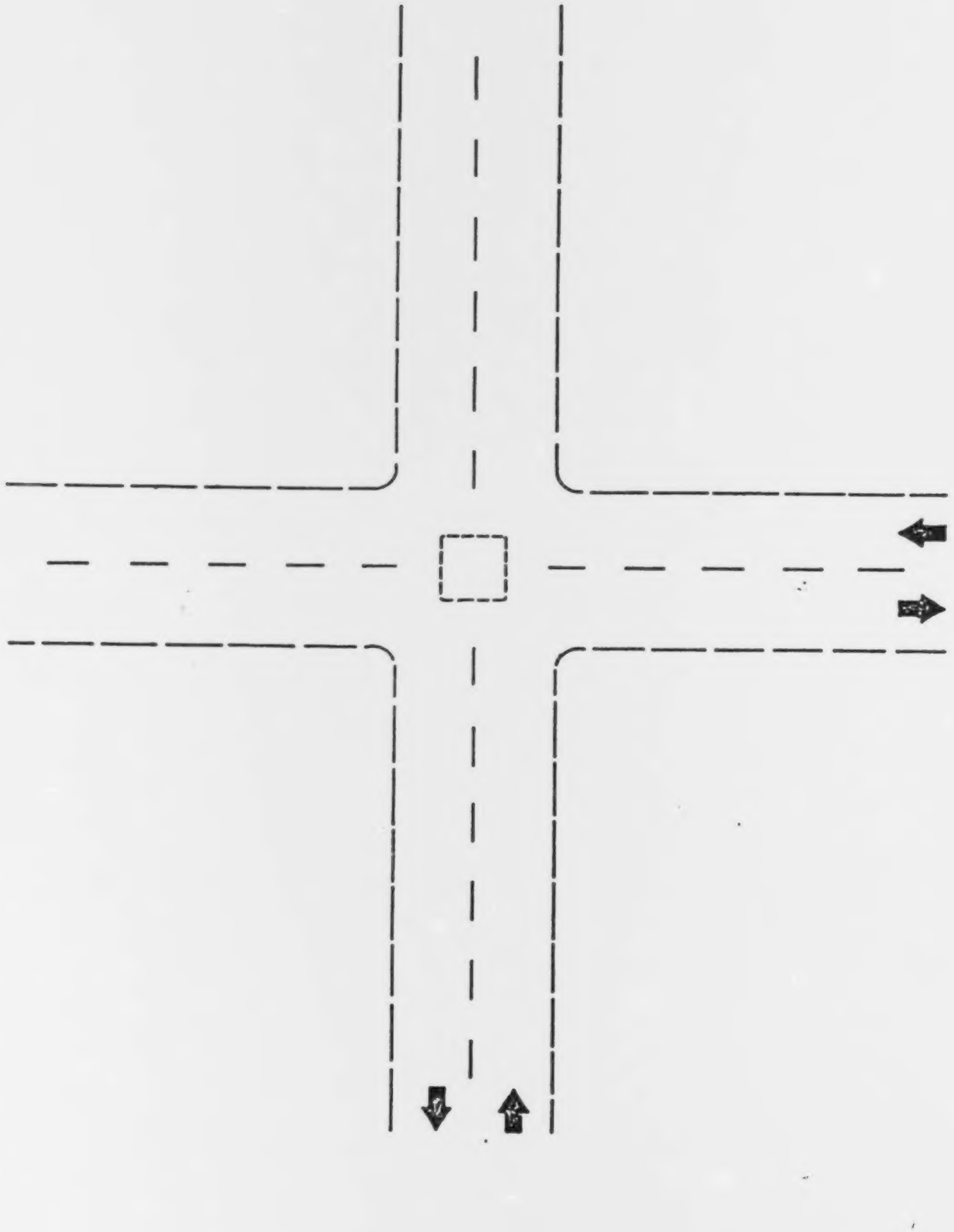
KEY:

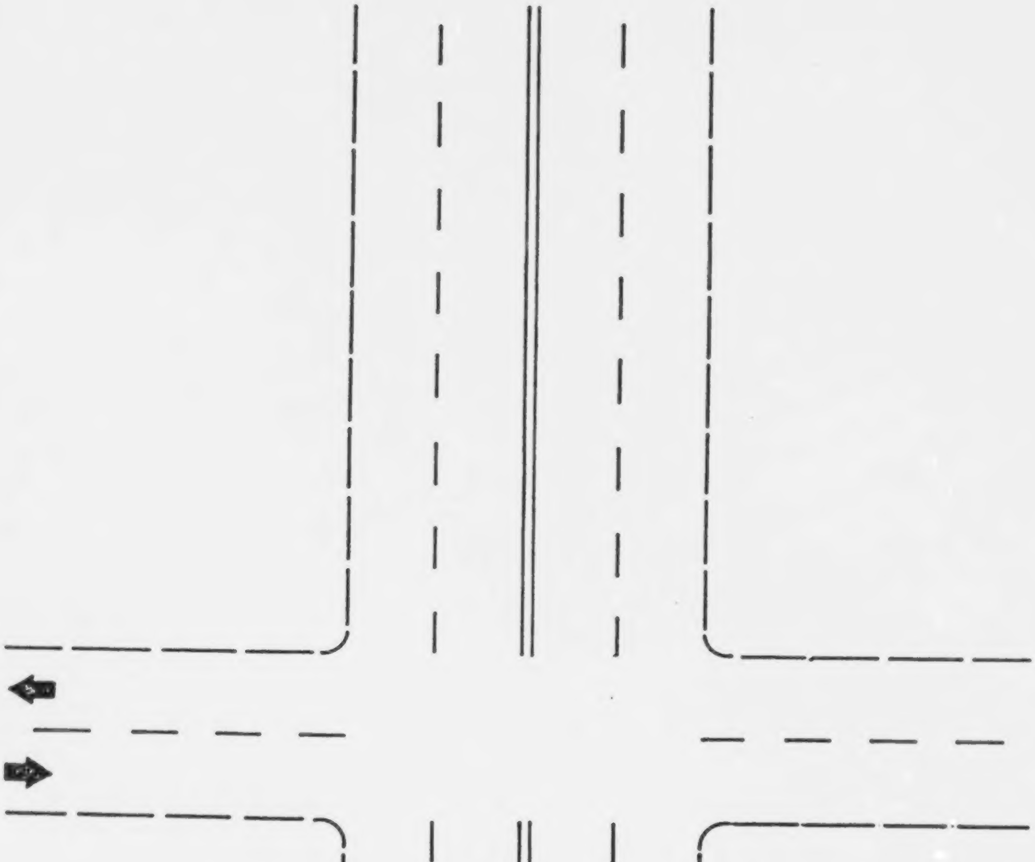
■■ Channelizing Devices
ooo Arrow Panel (Optional)
🔦 Flashing Warning Light (Optional)

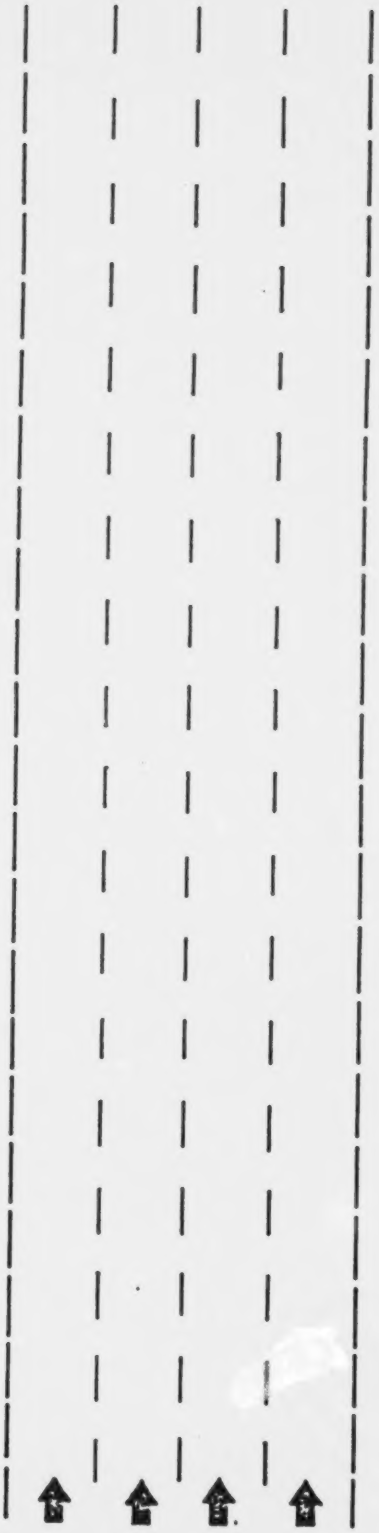
Figure 6-14 Typical Application—Four-lane Undivided Roadway, Where Half the Roadway Is Closed (MUTCD, Figure 6-7)

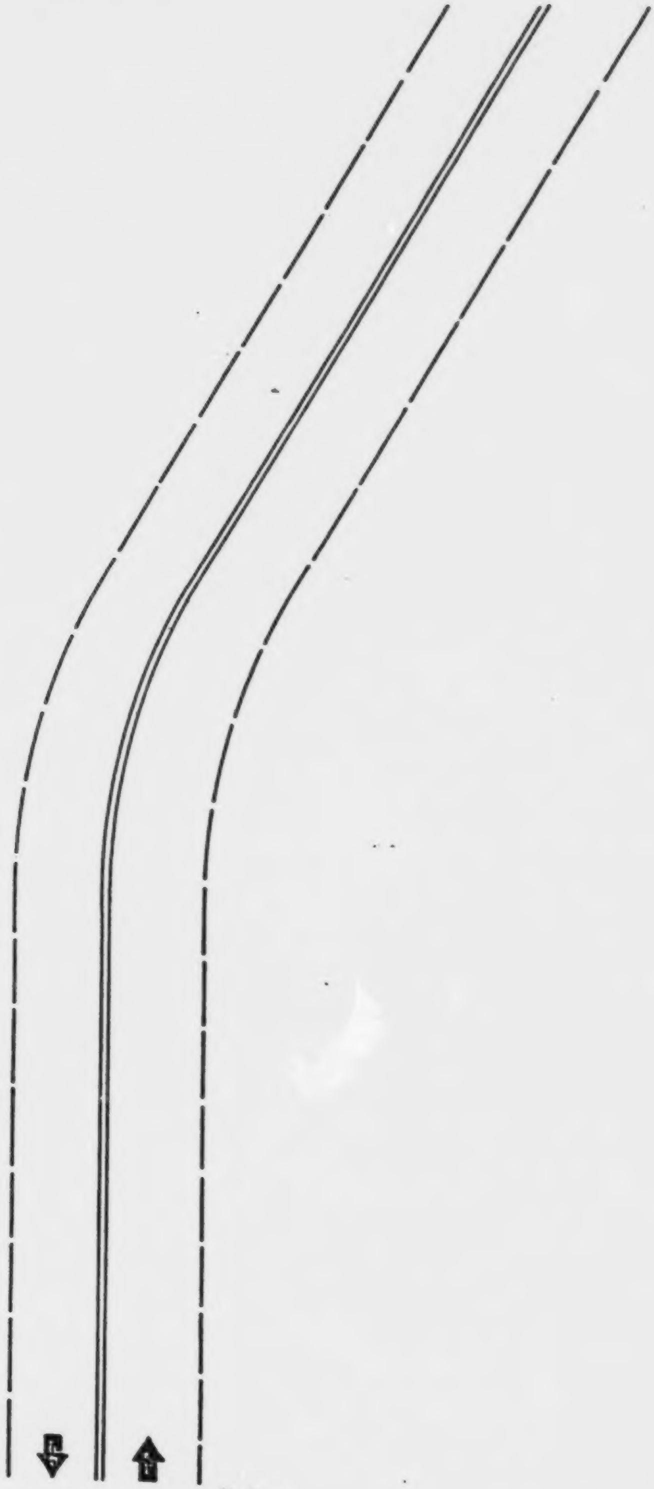


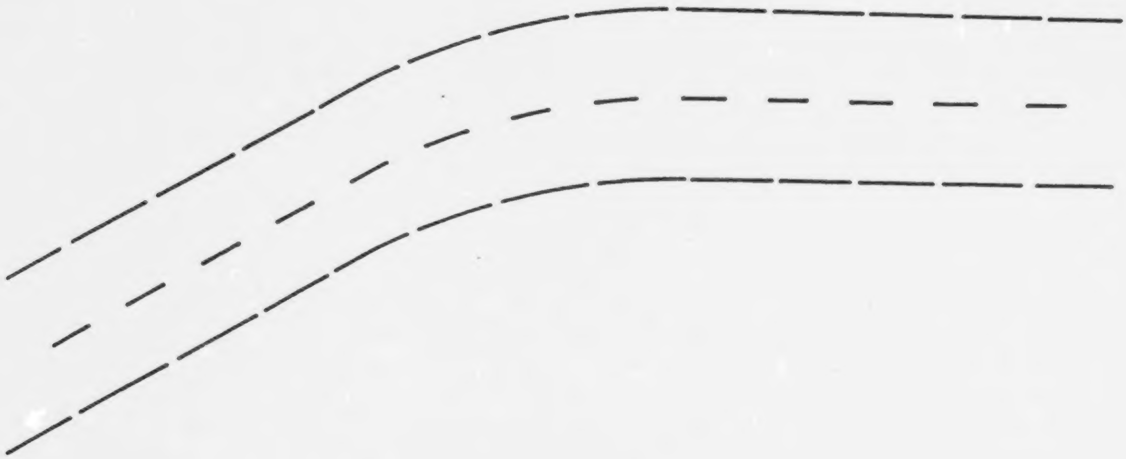




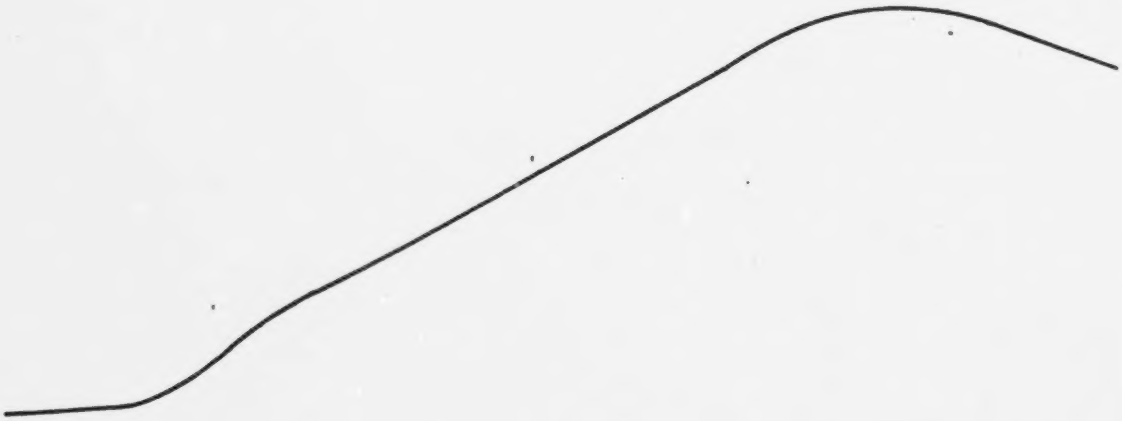








PLAN VIEW



PROFILE

Original

Final Evaluation Repo

Idaho Cooperative Demonstratio

Construction and Mining

Prepared by

Dr. Thomas R. Owens
Education and Work Program
Northwest Regional Educational Laboratory
101 S.W. Main Street, Suite 500
Portland, Oregon 97204

June 29, 1990

Final Evaluation Report of the Idaho Cooperative Demonstration Project in Construction and Mining

This final evaluation report summarizes the: 1) evaluation design; 2) a meeting held in Washington, D.C. with the project monitor; 3) the monthly reports by the six project coordinators; 4) staff interviews; and 5) summary of telephone interviews with industry representatives. The Idaho Cooperative Demonstration Project is being evaluated internally by the Project Construction Specialist and state staff, while the external evaluation is being conducted by the Northwest Regional Educational Laboratory (NWREL).

1. Evaluation Design

The external evaluation design was prepared by Dr. Thomas Owens of the NWREL staff in March 1989 and reviewed and approved by Dr. Don Eshelby, Program Services Director for the State of Idaho Division of Vocational Education. The design specifies the purposes for the evaluation, questions to guide the evaluation, data collection procedures, timeline, and reporting arrangements. A copy of the design is shown in Appendix A.

2. Interview with Program Monitor

On December 1, 1988, Tom Owens met in Washington, D.C. with Bob Miller regarding the Idaho Apprenticeship Project and their evaluation expectations. His branch chief, Glen Boerrigter, joined the group.

They are interested in whether the projects are successful and in how partnerships get developed with the private sector. However, officially, they cannot state what they want from the evaluations. They have also contracted with the Associated General Contractors in D.C. for a project. He felt that both AGC and NOCCTI may have some useful student tests. Clev Randall from their division of vocational technical education is their contact person for the Department of Labor. I wanted to visit Randall, but he had already left for AVA.

Their office moved recently and they got rid of many documents. Therefore, they had no exemplary evaluation designs or reports to share with Dr. Owens.

3. Summary of Monthly Reports

This section starts with a narrative summary of program accomplishments and then displays a monthly tabulation of people served and contacts made by the coordinators.

Narrative Summary

SCHOOL	NAME	TIME COVERED
College of Southern Idaho	Bennie Knodel	June 1989-January 1990

Bennie Knodel visited with various contractors, held flagging/basic traffic classes, and planned classes in first aide, blueprint reading, and other pre-apprenticeship classes. His contractor survey indicated the greatest training interest in: first aide and CPR (15 people) and blueprint reading (9 people).

North Idaho College	Richard Caron	January-May 1989
	Don Bennett	July-February 1990

Richard Caron attended a 40-hour Mine Safety and Health Administration training class in January, collected safety training materials and curricula, and became familiar with the mine site and instructors. He coordinated the hard rock mining and the diamond drilling programs. A segment of the training was shown on KHQ television in Spokane.

Don Bennett planned and organized the eight-hour 1990 National Electronic Code (NEC) Update class for electricians which was taught in April. He also met with representatives of NIC and the USDA Soil Conservation Service to discuss a proposed soils technician two-year degree program and with representatives of the Potlatch Complex in St. Maries to review their proposed apprenticeship program. Arrangements were also made with company representatives to implement pre-employment training, apprenticeship training, and a rehabilitation training program. He also implemented a truck driver qualification program.

A hard rock mining school was held in July but there was inadequate labor market need to justify future classes in this area. Don started a pre-apprenticeship class plus two flagging classes. He also made regular contacts with contractors and contractor associations and distributed a flyer for a truck driver training program.

Idaho State University	Duane Gagon	April-December 1989

Duane Gagon conducted flagger classes for 108 people and updated the manual. Visits were made to contractors concerning a blueprint reading class and one on backhoe operations. He also attended the Backhoe training for the City of Blackfoot and arranged for a Concrete Seminar attended by over 40 people.

Lewis-Clark State College	K.D. Dempsey	July-November 1989

Mr. Dempsey made numerous contacts with contractors and developed curricula in construction, truck driving, first aide and CPR, blueprint reading, sheet metal, construction equipment operations, and hazardous material communication.

Eastern Idaho Vocational-Technical School | Roger Orme | February-November 1989

Roger Orme attended asbestos upgrade training in Albuquerque, New Mexico, conducted flagging classes, organized asbestos classes, contacted mining companies, and conducted apprenticeship orientation. He also mailed surveys to 169 area contractors and got labor union input. The contractor surveys indicated the greatest training needs in: supervisory training program (checked by 68 percent of the contractors) first aide and CPR (64 percent), blueprint reading (60 percent), and concrete seminar (48 percent).

Roger's contacts with small businesses generally indicated they were not highly interested in training and were fearful of forming, jointly with their competitors, a training pool of workers. The people from Salmon asked to have a flagging class there.

He attended the Rocky Mountain Apprenticeship conference in Reno, Nevada.

TABLE 1

Monthly Tabulation of Coordinators' Monthly Reports

	1 Boise State University	2 College of S. Idaho	3 Eastern ID VTS	4 Idaho State University	5 Lewis-Clark State College	6 N. Idaho College
Number of Pre-Apprentices Served	*1	*2	85	148	44	54
Number of apprentices Served			64		18	0
Number of Journeymen Served					62	63
Number of Females and Minorities Served					98	40
Number of Curricula Developed				1	16	4
Staff Training Sessions Attended				3	11	2
Public and Private Sector Contacts		64	6	59	294	231

Notes:
1. No data reported
2. Data reported in terms of coordinator's time rather than people served
3. February to November
4. April to December
5. March to October
6. January 1989 to February 1990 data

Idaho Cooperative Demonstration Project
Employer Interview

Following an introduction of myself and brief purpose for the interview, the following questions will be asked:

1. What type of training was conducted in your company through this project?
2. About how many people were trained?
3. What do you think were the strengths of this training?
4. What do you think were the weaknesses of this training?
5. Would you be interested in having the same type of training provided in the future? Why?
6. Would you be interested in having other types of training provided? If yes, what types?

300

4. Interview with Division of Vocational Education Staff

The Idaho Cooperative Demonstration Project in Construction and Mining was considered by state staff to have made some important contributions in Idaho. Between 2,500 and 3,000 people were trained through this project. Most of them were trained in flagging. The curriculum developed was considered excellent and the Idaho Transportation Department will contract to have the training provided through the vocational education system. Relationships with the Department of Employment have improved and a system has been developed to identify construction people who are unemployed. These people are sent a flyer describing construction training programs offered through the state's vocational technical schools. The truck driver training developed through this project may be picked up by the unions. The carpenter training will be offered in September through Boise State University for high school and adult populations. High school students can attend on a half-day basis as a result of an articulation agreement with the public schools. High school counselors were educated to teach students about apprenticeship opportunities in their community.

Although the training project was considered successful, it did not reach as many people as possible. Staff feel that apprenticeship training could be offered in every city in the state.

5. Interview with Employers

Dr. Owens conducted six telephone interviews with a sample of employers in five areas of the state. The purposes of the interviews were to determine the type of training provided, perceived strengths and weaknesses of the training, whether employers would be interested in having the same type of training in the future, and what additional types of training might be desired.

The training covered flaggers, truck drivers, concrete workers, and construction workers. Training usually ran 4 to 8 hours and was provided to 3 to 20 workers per company. In each company, the employer spoke positively about the training and quality of instructors. The visual training aids were considered particularly good in the traffic control classes. Instructors were considered knowledgeable in their fields, informed about the new regulations, and able to relate to the workers. At least one instructor also helped the employer learn where to go for extra help and resource materials needed.

Only two areas were suggested for improvement. One was to lengthen the flagger training by adding one day of hands-on practice. The other was to make the safety training more specific to the needs of their particular company.

Several employers were uncertain as to whether they would want more of the training received. One company was considering providing their own flagger training and several felt the training provided had already met their needs. In terms of other areas where training would be desired, the only examples given were for first aid and advanced first aid training.

APPENDIX A

EVALUATION DESIGN FOR THE IDAHO COOPERATIVE DEMONSTRATION PROJECT IN CONSTRUCTION AND MINING

Prepared by:

Dr. Thomas R. Owens
Education and Work Program
Northwest Regional Educational Laboratory
101 S.W. Main Street, Suite 500
Portland, Oregon 97204

March 6, 1989

EVALUATION DESIGN FOR THE IDAHO DEMONSTRATION PROJECT IN CONSTRUCTION AND MINING

This design is intended to guide the 1989-90 external evaluation of the Idaho Cooperative Demonstration Project. The Northwest Regional Educational Laboratory (NWREL) has been contracted by the Idaho Division of Vocational Education and CAVES to conduct an independent evaluation of the Project. The design consists of the proposed evaluation questions to guide the evaluation, data collection procedures, timeline, and reporting arrangements. The evaluation is being conducted to provide feedback to the staff for program improvement and to document the processes and outcomes of the Project. The latter information should be of special interest to those thinking of adopting all or part of this Cooperative Demonstration project, to policy makers, and to staff of the U.S. Department of Education.

In addition to this external evaluation, the Project Construction Specialist and State Staff will be conducting an internal evaluation. The internal evaluation will measure the quality of instruction, course content, and program efficiency. The internal evaluation will include a student survey and an administrative evaluation regarding the quality of instruction, course content, instructor effectiveness, and quality of facilities. As part of the external evaluation, the NWREL staff will review the internal evaluation findings.

Evaluation Questions

The external evaluation questions were developed as a result of reviewing the project proposal, discussing the information needs with the project monitor in Washington, D.C. and discussion with the Project Construction Specialist.

1. To what extend are the program objectives being met in terms of:
    a. Developing an approved curriculum in construction and mining
    b. Providing preapprenticeship training in equipment operation and/or construction truck driving to approximately 30 women and monitories
    c. Providing approximately 250 students with related instruction in the five basic construction trades--equipment operation, construction truck driving, cement masonry, carpentry and laborers
    d. Providing 480 hours of instruction for 144 mining students
    e. Providing upgrade classes for approximately 350 students in technical areas
    f. Forming and working effectively with advisory committees in the technical areas, and
    g. Collaboration established between CAVES, the Associated General Contractors, Bureau of Apprenticeship and Training, and the participating employers and organizations
2. What contributed to the successes and failure of the various components of the project?

How effectively has [illegible] [illegible] [illegible] interested parties in [illegible]

Data Collection Procedures

Because the resources available for the NWREL external evaluation are quite limited, we will rely on analysis of the internal evaluations where possible and will synthesize project documents such as the monthly reports from the separate sites. In addition, we will conduct telephone interviews with key staff at a sample of four of the Cooperative Demonstration project sites to determine progress, problems encountered, and suggestions for improvement. The NWREL evaluator will meet with the Advisory Committee at the end of year one to share the external evaluation findings.

Timeline

Listed below are the three major tasks and the proposed timeline for each.

Task	Completion Date
Evaluation design	March 15, 1989
Interim evaluation report	December 31, 1989
Final evaluation report	June 30, 1990

Reporting Arrangements

The dates for the interim and final report are specified in the timeline above. The evaluator will make an oral presentation at the meeting with the Advisory Committee. In addition to the final report the evaluator will prepare a one to three page executive summary that can be shared widely. Although budget limitations preclude the evaluator from meeting with the Advisory Committee on a regular basis, he will be readily available by telephone contact.

INDEX

ITEM PAGE NO.

- Abbreviations 74
- Architectural Services 1
- Commercial Buildings 21
  - Drafting Techniques 21
  - General Impression 21
  - Procedure 21
- Construction Drawings 1-4
- Contour Lines 19
- Design 27
- Detail Drawings 28
- Door Details 5, 26
- Drawing Organization 5, 6
- Electrical Drawing 4, 6, 22
- Elevations (Reference) 19
- Elevations (View) 3, 25, 26
- Elevator and Stair Details 6
- Exterior Elevations 5, 24, 26
- Floor Plan 3, 5, 22, 23
- Food Service Details 6
- General Millwork Details 6, 26
- Glossary 32
- Interior Elevation 6, 30
- Linework and Symbols 6-9
- Lines 6-9
  - Break 7
  - Center 7
  - Dashed or Hidden 6
  - Dimension 7, 24, 26
  - Extension 7
  - Object or Visible 6

ITEM PAGE NO.

  - Section . . . 7
- Measuring . . . 16
- Mechanical Drawings . . . 3, 6, 22
- Miscellaneous Details . . . 6, 25
- Plumbing Drawings . . . 6, 22, 26
- Preliminary Drawings . . . 2
- Presentation Drawings . . . 2
- Reflected Ceiling Plan . . . 5
- Roof Plan . . . 5, 26
- Scale . . . 14-17, 19, 29
  - Architech's . . . 14
  - Drawing Symbols . . . 17
  - Drawing To . . . 14
  - Reading A . . . 15
  - Surveyor's . . . 19
  - Using Folding Rule to . . . 16
- Scaling and Dimensional Practices . . . 14-17, 29
- Schedules . . . 3, 9-11
  - Column and Footing . . . 10
  - Door . . . 10
  - Mechanical and Electrical . . . 11
  - Room Finish . . . 9, 10
  - Slab and Beam . . . 11
- Sections . . . 3, 5, 22
- Shop Drawings . . . 4, 11, 12
  - Beams . . . 12
  - Structural Steel . . . 11
- Site or Plot Plan . . . 3, 5, 17, 20
- Sketches . . . 1, 2
- Special Contract Drawing . . . 6
- Structural Drawings . . . 3, 6, 21, 27

ITEM

PAGE NO.

Survey Plat 18
Symbols 102
Title Sheet 5
Window Details 5, 26
Working Drawings 2-4, 12
    Definition and Purpose 12
    Materials and Equipment 12

The complete instructions for the construction of a commercial building consists of two major parts: a set of working drawings and a set of written specifications to accompany the drawings. Both are important in covering the complete information. Together, with Bid Forms and Legal Contracts, they constitute what are known as the *Contract Documents*.

ARCHITECTURAL SERVICES

Whereas an owner usually deals primarily with the builder in residential construction, the *architect* or architectural firm is usually the principal contact of the owner in commercial construction and represents the owners's interest during the building process. Although an architect is sometimes involved in residential construction, typical architectural practice is concerned, almost exclusively, with commercial construction.

The architect usually provides *five* basic services for a client (owner). These are defined as AIA (American Institute of Architects) documents B 141, the Standard Form of Agreement between Owner and Architect. They are:

1. Schematic Design Phase (Preliminary)
2. Design Development Phase
3. Construction Document Phase
4. Bidding and Negotiation Phase
5. Administration of the Construction Contract

Drawings are the tools the architect uses to convey his or her ideas and, through which, the architect ensures that the finished building is properly constructed and will serve the requirements of the owner. Almost all architects are skilled drafters and must be able to communicate the building instructions to the people involved in a construction project through the various drawings he or she produces.

CONSTRUCTION DRAWINGS

Drawings associated with commercial construction projects may be divided into five categories that are closely associated with their purposes: (1) Sketches, (2) Presentation Drawings, (3) Preliminary Drawings, (4) Working Drawings, and (5) Shop Drawings.

Sketches

When an architect is retained to design a building, he or she must first determine from the owner those items that are important for the function of the building. The architect usually sets these down in the form of a *program*. Sketches are then made to fit ideas to the requirements of the program. Plans, elevations, and some typical details are sketched and submitted to the owner to determine if the architect's solution is compatible with the owner's requirements. Many changes can occur during this schematic design phase until an agreement is reached.

Presentation Drawings

Presentation drawings usually consist of perspective views of a tentative building along with sections and schematic floor plans. The perspective view, and sometimes even elevation views, are drawn to present, as nearly as possible, the actual appearance of the building, making it possible to view the design as a finished product before committing it to construction. The purpose of these *renderings*, carefully landscaped with shadows and color, is to "promote" the design. A building must be *sold* before it reaches the working drawing stage; therefore, architectural artists are often employed to prepare colorful and artistic renderings for this purpose. These are drawn with the esthetics characteristics of the building as a predominant consideration. If the architect thinks that the project justifies it, a three-dimensional architectural model may be made for presentation to laypeople, who often have difficulty in interpreting architectural plans.

Preliminary Drawings

As the name implies, preliminary drawings are the beginning drawings prepared during the early part of the design development phase as a first step toward the preparation of the working drawings. Preliminary drawings are not meant to be used for construction and are usually stamped to indicate this. They are meant merely for exploration of original concepts, functional studies, material selection, preliminary cost estimates, preliminary approval by civil authorities, and as a basis for preparation of the final working drawings.

A large portion of the design work is reflected in the preliminary drawings. Although usually drawn at smaller scales (1/16" = 1"-0") then working drawings, they include most of the structural, mechanical, and electrical concepts, coordinated with the architectural features, to form a skeleton outline in graphic form. The preliminary architectural plans usually include only a Site Plan, Floor Plans, one or tow Elevations, and Typical Wall Sections. The structural plans usually include a Foundation Plan (to show the type of footings), Typical Floor Framing Plans (with estimated member sizes), and a full Cross Section (to show floor heights and wall thicknesses). The architectural and structural preliminaries are used by the mechanical and electrical engineers to determine the best locations for the mechanical and electrical equipment.

Only a few sets of prints are made of the preliminary drawings, and corrections and revisions are commonly recorded only on the prints. *They are of no further use after the working drawings have been prepared.*

Working Drawings

The finished product of the research, thought, and design that an architect puts into a building project is reflected in the set of working drawings. These drawings are the technical directions to the general contractor, in graphic form, showing the size, quantity, location, and relationships of the building's components that make it possible to build the project and make it a functionally successful structure. The drawings are prepared on translucent paper or film (called *tracings*) so that a sufficient number of prints can be made from them. Usually between 10 and 30 sets of prints are necessary for an average job, with even more sets required on larger projects. The time and effort expended during the construction document phase to produce the working drawings constitutes a major part of the total architectural service.

Sheets within the set of working drawings for commercial buildings usually are numbered in a logical sequence. The Site Plans are labeled SP-1, SP-2, etc.; the Architectural Drawings are labeled A-1, A-2, A-3, etc.; the Structural Drawings are labeled S-1, S-2, etc.; the Mechanical Drawings are labeled M-1, M-2, etc.; and the Electrical Drawings are labeled E-1, E-2, etc. An index is usually shown on the title sheet or first sheet to facilitate finding a needed drawing.

A typical set of drawings for a medium-sized building would consists of from 20 to 60 tracings on 24" X 36", 22" X 34", or 36" X 42" sheets and would contain the following types of drawings.

SITE PLAN: This drawing(s) shows the location of the structure on the property. The location of utilities, bench marks, drainage facilities, driveways, parking lots, and the existing and final contour lines, etc., are shown on one or more drawings.

FLOOR PLANS: A plan view of the foundation, each floor, and the roof is drawn to show the footing locations, location of walls and partitions, and sizes and locations of all doors, windows, and other openings.

ELEVATIONS: Elevation views of each side of the building are needed to indicate the materials required, finish grades, floor and ceiling heights, and general exterior architectural features.

SECTIONS: Longitudinal or transverse vertical sections through the building show material placement and construction details. Many sections are drawn to larger scales than plan views to show specific information.

SCHEDULES: Wall and floor finishes, window and door information, and bath and plumbing materials are indicated on "chart like" schedules. Many times these schedules are placed on the floor plans or sectional drawings.

STRUCTURAL: These drawings include foundation plans, floor framing plans, roof framing plans, and sections showing the sizes and types of structural components of the building.

MECHANICAL: Plumbing, heating, and air-conditioning features are shown in detail on these drawings. Isometric or other pictorial views are often used to show complicated piping or ductwork.

ELECTRICAL: Wiring, electrical switches, and electrical fixtures are shown on floor plans and in schedules.

Shop Drawings

These are technical drawings prepared by the various trades participating in the construction and used mainly by their own mechanics. On many jobs, the architects and engineers must rely on specialists or material suppliers to furnish precise information. Details concerning reinforcing steel, elevators, conveyors, complex cabinet work, etc., are commonly furnished by the suppliers. For example, even though the structural drawings show the size, location, and typical splicing laps for reinforcing bars, the steel fabrication firm in its own drafting department prepares drawings that show each type of bar required, the number needed, placing information, and the number and type of bar supports required to hold the bars in place during the concrete pouring operation. These shop drawings are submitted to the structural engineer, who checks for design only, and to the general contractor, who checks only for quantity. The drawings are then stamped with such phrases as "furnish as submitted," "furnish as corrected," or "revise and resubmit." When the review of the drawings indicates compliance with the contract documents, the reinforcing steel fabrication firm can then begin cutting and bending the steel for delivery to the job. Shop drawings also allow the architects and engineers to review the quality of the components that subcontractors propose to furnish.

The differences in the techniques used in commercial building working drawings stem from the greater complexity of the buildings and the need for consultation with engineers to assist the architect in the preparation of the structural, mechanical, and electrical features of the building.

Standardization among the offices of those professionals preparing working drawings is highly desirable in making the reading of these drawings easier and misunderstandings less likely. The builder could be confident that the intent, abbreviations, symbols, and system of organization of the working drawings would be reasonably consistent among all design professionals. Unfortunately, complete standardization has not been accomplished and it is unlikely that it will come about suddenly. Some government agencies and private corporations have established standards for the drafting of documents for their own projects that are at variance, or even in contradiction, with usual procedures. Of course, design professionals must conform to these unique standards when doing work for those agencies or corporations. The use of computers to aid in the preparation of drawings should achieve a more complete standardization of drawings techniques; however, the lack of standardization in the computer industry, itself, does not lead to a high degree of confidence that it will be achieved soon.

It should be helpful to those who read working drawings to have some understanding of the process by which the drawings are produced. Many questions regarding why this or that was done will be answered when the reader has an understanding of the production process.

DRAWING ORGANIZATION

Working drawings are most often made, in pencil, on rather large sheets of good quality tracing paper. The sizes 22" X 34", 24" X 36", or 30" X 42", being the most common, are many times dictated by the size of the building project. Usually the sheet size and the format regarding the borders and title block are chosen by the architect and printed in that form by a local commercial firm that specializes in providing this service. These preprinted sheets are usually provided to the consulting engineers so that all drawings will have a uniform appearance. Although some architects prefer no borders, most use a heavy border line to minimize the effect of torn or frayed edges that will occur with most drawings during the production process. Most layouts have a wider binding margin on the left edge of the sheet. This title block is sometimes placed in the lower-right corner, but most architects prefer to use a title block that extends all along the right edge of the sheet. Title blocks usually contain the architectural firm name and address, the sheet number, the project name and address, the project number, the release date, drafter and checker identification, space for revision notations, and sometimes space for the seals of the architect or engineer.

While slight modifications will be found, most project working drawings are usually arranged in the following sequence:

Title sheet, containing the project title, owner's name and address, index of drawings, location sketch, and other general information.

Site plan, sometimes several sheets, containing the soil-boring log, grading information, drainage structures, and planting and landscape details.

Floor plans include partition locations, window and door indications, room finish schedules, and special notes.

Reflected ceiling plans contain information regarding ceiling materials and changes in ceiling heights.

Roof plan indicates roof slopes, roof details, and special drainage devices.

Exterior elevations show the exterior appearance of each side of the building, materials used, floor and roof elevations from some datum, and exterior window and door treatment.

Building sections are wall sections, roof/wall intersections, and transverse and/or longitudinal sections through the building.

Window details include window schedules and head, jamb, and sill details.

Door details indicate door and frame details, door schedules, and door hardware. Sometimes included on sheet with window details.

Elevator and stair details.

Interior elevations including interior details.

General millwork, including cabinet details.

Miscellaneous details.

Structural drawings, including foundation plan, floor framing plans, roof framing plan, and beam connection and reinforcing details.

Plumbing plans and details.

Mechanical plans, including heating/cooling plans and details.

Electrical plans and details.

Food service plans and details.

Special contract drawings.

LINEWORK AND SYMBOLS

Since commercial buildings are usually large in plan, a scale of 1/8" = 1'-0" has become the industry standard for drawing the plan views of the building. As is stated in Volume I, this great reduction in size in which views of a building must be made makes it necessary that many symbols be used on the architectural drawings and on the engineering drawings that accompany them. The lines themselves are symbolic in that heavier lines indicate components or portions of a building that have more importance than others.

The descriptions of the various types of lines used in architectural working drawings which are listed in Volume I are worth repeating here because they apply as well to commercial building drawings.

OBJECT OR VISIBLE LINES: Prominent lines representing the edges of surfaces or the intersections of two surfaces.

DASHED OR HIDDEN LINES: Medium-weight broken lines made with uniform dashes. They represent hidden surfaces or intersections; or on floor plans they may be used to represent minor features that fall above the plane of the drawing, such as high wall cabinets in a kitchen. Occasionally, on drawings used for remodeling a building, they indicate the position of the old construction. In other cases they are used for relationship clarification or to show alternative positions of a movable component.

CENTER LINES: Fine lines made with alternate dot and dashes. They show symmetry on the axis of circular features and are used to locate centers of windows and door symbols on floor plans. To further distinguish center lines from object lines, center lines are extended slightly beyond the outline of the view for which they indicate symmetry.

DIMENSION LINES: Fine lines with arrowheads at their extremities to show the extent of a given dimension. Numerical dimensions are placed directly above the lines near their centers.

EXTENSION LINES: Fine lines that relate the dimension lines to their features. They do not touch the features; instead, they start about 1/16" from the feature and extend about 1/8" beyond the arrowheads of the dimension line.

BREAK LINES: Fine lines with offsets to show a break or the termination of a partial view. Architects frequently use break lines to eliminate unimportant portions of details, thus allowing the important portions to be larger. Small break lines are often fine, ragged lines done freehand.

SECTION LINING: Fine linework, usually angular, giving a tone to sectioned surfaces and made with the conventional symbol of the surface being cut.

Working drawings are usually drawn to precise scale to show the components of a building in the correct relationship to one another. Minor and even major errors can result from inaccuracies of scale. While the plan is most often drawn to a scale of 1/8" = 1'-0", details are usually drawn to scales of 1/2" - 1'-0", 3/4" = 1'-0", or larger. Using a scale of 3/8" = 1'-0" is not recommended by many professionals. However, unlike drawings for residential construction, nothing should be "measured" from the drawings even if a dimension is left off the drawing. In the case of missing or incorrect dimensions, the architect or engineer should be consulted so that the correct dimension can be determined. Occasionally, the layers of materials, such as roofing membranes or sheet-metal details, cannot be shown clearly without exaggerating the linework to show a separation of lines even though there will be no separation in the finished construction. Sometimes late changes may require that a detail must be revised, and it may be impossible to show these changes to the correct scale unless the detail is completely redrawn. To save time, in cases such as this, the detail may be labeled "No Scale" or "NTS" (meaning not to scale) or, as happens many times, no indication of the change is made and parts of the drawing are out of scale.

Line weights for structural drawings generally follow those used on the architectural drawings, although in the interest of clarity certain items and components receive more emphasis. Since the purpose of the drawings concerning concrete reinforcing is to indicate the reinforcing, the American Concrete Institute (ACI) recommends that the line weight of the reinforcing shown on the drawing be a heavy solid line, even though, technically, it should be a dashed or hidden line. Not all engineers follow this recommendation, but the drawings of those that do follow it are easier to read and result in fewer mistakes on the part of the contractors who must read the drawings. When showing concrete reinforcing, no distinction is made for the size of the reinforcing; large-

314

and small-diameter bars are drawn with the same line weight.

Structural steel framing plans are usually drawn as schematic diagrams with heavy solid lines indicating the various steel beams and girders. As has been discussed, the small space shown at the ends of the lines representing some beams means that the connections for those beams are required to be simple or nonmoment-type connections and that standard framed connections can be used. Notice also that the beams framing into the outside of the column support have no space left between the beam and the column. These beams are cantilevered from the column, and the lack of a space indicates that the connections for those beams should be moment-type connections.

The mechanical plans show the ductwork for heating and/or cooling by the use of symbols indicating various features. Often shading within the linework indicating the ducts is used to emphasize the ductwork. The location of thermostats, exhaust fans, and door grills is also shown on the mechanical plans. Plumbing plans show the sizes and location of water pipe and sanitary waste pipe by the use of heavy solid or dashed lines. Plumbing riser diagrams are often shown as isometric line drawings in a pictorial view to indicate the vertical and horizontal runs of pipe to make the three-dimensional nature of the plumbing easier to understand. Electrical plans show the location of light fixtures, and the wiring is indicated by heavy schematic lines on the floor plans. Usually, the power lines required to furnish power to the various motors and equipment are shown on a separate floor plan. Many symbols are used on the mechanical, plumbing, and electrical drawings.

Several views or sections are almost always found on the drawings for buildings. Some of these sections are called "typical" because the section is common to many parts of the building. Typical Wall Sections, Longitudinal Sections, and/or Transverse Sections are found on most plans. These are usually full sections that show the entire wall or building in the section. However, most sections shown on drawings are *partial sections* in that they are cut through only a part of the building or its component. Sometimes a reference symbol is shown where the section is cut, but many times no reference is given. However, less misunderstanding occurs when the reference symbol is shown.

Although details may include plan views, most are large-scale enlargements of portions of sections. Certain conventions are used with some sections and details. For example, those sections through the head, jamb, and sill of doors and windows are almost never referenced and are shown as if only a vertical cutting plane were used. However, the cutting plane for the jamb is horizontal, although the sections are usually placed one under the other on the drawing.

Material symbols are almost always indicated on sections and they are most important because they show the relationship of the various component parts in the building. The symbol for *miscellaneous materials* is produced by a halftone (usually made by a colored pencil shading on the back side of the tracing). It is a simple and quick method for the identification of a large area of the same material. This same symbol is used widely as a substitute for the concrete symbol by engineers on structural drawings, since there is the possibility that some of the dots used in the concrete symbol might be mistaken for the end view of reinforcing steel.

Many times sections shown on the architectural drawings must be reviewed again to fully understand a similar section on the structural or mechanical drawings, and vice versa. The architectural drawings usually show the dimensions and the relationship of the materials in detail and indicate the structure in very simplified form, whereas the structural drawings will show the details of the structural steel or reinforcing and indicate the surrounding materials in general. Usually a note will direct the reader to the associated architectural or structural detail. While this may seem confusing, it is the general practice of most architects and engineers and eliminates a duplication of effort.

Architects and engineers know that it is very important that the sections and details be coordinated with the specifications. The drawings illustrate and dimension the construction and identify the materials, while the specifications describe the quality of the materials and the specifics of the installation. Sometimes it is necessary to refer to the specifications to understand the nomenclature used on a detail. For example, the term "Exterior Insulation and Finish System" could only be understood by reading that particular section in the specifications. Terminology also must be consistent. If a detail calls for a "folding door" and the specifications call it a "folding partition," contractors will naturally be confused. While care is taken to avoid these mistakes, contractors should inform the architect or engineer when errors of this nature are found so that clarifications can be made before mistakes occur in the construction.

SCHEDULES

Schedules for various components and conditions are used extensively on working drawings. They are a convenient way of organizing variable conditions. Architectural drawings show schedules for room finishes, for doors, and sometimes for windows, and for other variable items. The structural drawings will have schedules for footing reinforcing, beam reinforcing, columns, joist bridging, lintels, and other components. The mechanical and electrical drawings will show schedules for plumbing fixtures, fans, air distribution, mechanical equipment, lighting fixtures, panelboards, and other items.

While schedules save time and effort on the part of those who prepare the drawings, they require a high degree of understanding on the part of the reader of working drawings to interpret them correctly. Schedules are most easily understood when they are placed on the drawing sheet with the items scheduled; however, this is not always possible. Various identification marks and symbols are used to correlate the components with the conditions requiring the schedule, and it is necessary to be familiar with the legend (usually placed close to the schedule on the drawing) explaining the marks and symbols used.

Room Finish Schedules

These schedules (sometimes called interior finish schedules) describe the material and/or the finish to be used on the floor, base, wall, and ceiling and usually give the ceiling height. Sometimes the room area is also shown. The spaces to be finished are identified by mark, room number, or in some cases, when the building is small, by the room name.

Room finish schedules provide the contractor with a convenient way of estimating the amount of various materials necessary for the interior finish of the building.

Door Schedules

Doors (and framed openings) are identified in these schedules by a mark or opening number and give the type of door (usually related to a drawing of the door), door size, composition (hollow core, solid core, folding, etc.), material (wood, steel aluminum, glass, etc.), the frame types (usually related to a drawing), and head, jamb, and sill details (also usually related to a drawing of the various types). Window schedules, although not as frequently used, follow the same general format as door schedules. Hardware for doors (and windows) is usually found only in the specifications. Although the number of various door types usually is not given, the door schedule does provide a help to contractors when they are estimating the cost of doors for a project.

Column and Footing Schedules

While the structural framing plans furnish information concerning the size of beams and girders required in a building, the size of columns is almost never found on the framing plans. Even in small commercial buildings, column information is usually provided in column schedules. These schedules are different from most schedules in that they are somewhat pictorial. The columns are shown as if they are all standing next to one another and the reader is viewing them in elevation. The levels of the various floors of the structure are indicated, although the distance between floors is not usually drawn to scale. Both reinforced concrete and structural steel column schedules are handles in a similar manner. The number and size of reinforcing bars or the size of the steel member that extends from one level to another is shown on the schedule.

Columns (and footings) are identified on drawings either by a sequential number system or, in larger buildings, by a grid system. The columns that are identical are grouped together in the schedule. Reinforcing bar patterns and splices are usually shown in details that accompany the schedules. In the case of steel columns, the splice points for the columns are shown on the schedule. These splice points are usually **not** at the level of the floor but are located some distance above floor level. While this simplifies framing of beams to the column, the real reason for the location of the splice above the floor level is that the bending stresses in the columns are a minimum at this point.

Footings are often included with columns in a schedule because the size of the footing and its reinforcing are controlled by the same loads that are used to design the columns. Many times these loads are shown on the schedule. The number and size of both the anchor bolts for steel columns and the dowels for concrete columns that must be inserted in the footing when it is poured are included in the schedule, and often details of these components are shown adjacent to the column and footing schedule. When necessary for the support of the footings, bearing piles are usually shown in a separate schedule.

Slab and Beam Schedules

These schedules are usually referenced to a detail of typical slab or beam reinforcing. An identifying mark, such as S-1 for slabs and B-1 for beams, is used to differentiate the various slabs and beams on both the framing plan and schedules. The terms "noncontinuous end" and "continuous end" refer to the ends of the slab (or beam) that does not have, or has, another slab (or beam) in the next section beyond the support. While the use of these types of schedules is widespread and makes the job of defining the reinforcing in a concrete structure much more simple for the drafters, interpreting the information in the schedules requires an intimate knowledge of the proposed construction and all the procedures involved.

Mechanical and Electrical Schedules

While the mechanical and electrical drawings show the location and extent of the heating, air-conditioning, plumbing, electrical wiring, and switching equipment superimposed on the building floor plans, many schedules are used to indicate other specific information.

These schedules also contain much design information relating to the capacities of the mechanical and electrical systems. Heat loss information, air volumes expected through various diffusers, and required horsepower ratings for electric motors are just a few of the types of design items contained in schedules.

Although the specifications contain parameters for acceptable equipment, schedules often list manufacturers' catalog numbers of preferred equipment, such as water heaters, electrical fixtures, and air-handling units. It is likely that schedules will be used more extensively on the mechanical and electrical drawings than any other drawings in a set of building plans.

STRUCTURAL STEEL SHOP DRAWINGS

Many different kinds of shop drawings are required to be submitted to the architect or engineer before the product can be installed in a building. Structural steel, concrete reinforcement, precast concrete, cabinetwork and millwork, elevators, and fire sprinkler systems are some typical items that require shop drawings. Except for the structural steel shop drawings, most are readily understood.

The shop drawings for the structural steel beams, girders, and columns show the required details for their fabrication, and they seldom picture the adjacent members to which they will be attached in the finished building. The member connections chosen by the fabricator are usually shown on either the beams or the columns. The size of the connection is based on the beam reactions and is usually selected from the **Framed Beam Connections** table in the AISC manual.

Beams

Details for beams are drawn to a scale of 1" = 1' - 0" for beams 21" or less in depth and 3/4" = 1' - 0" for larger beams. The length of the beams is rarely drawn to scale and is usually foreshortened (but is sometimes lengthened) on the detail for the convenience of showing all beams the same length on the drawing. The length shown is just sufficient to show all details along the length of the beam to scale. The dimensions are always shown and are critical, since the lengths of almost all beams are out of scale. Dimensions are usually given to the center lines of beams, to the backs of angles, and to the backs of channels. Vertical dimensions are usually referenced to the top (on rare occasions to the bottom) of beams, but **never to both** the top and bottom.

Lines called **gage lines** (usually spaced 3" apart) are drawn along the length of a beam detail. Usually, the first gage line is located 3" down from the top flange of a beam. All drilled (or punched) holes in the web of the beam should be located only on these gage lines. This makes fabrication of a beam much easier for shop personnel. Beams are usually fastened to each other by **connection angles**, which are two angles bolted opposite each other on the end of a beam. The leg of the angle that is fastened to the web of the beam is called the **web leg**, while the other leg is called the **outstanding** leg. Sufficient information must be given on the shop drawings to locate the position of all bolt holes in each angle.

To allow for different top elevations of connecting beams, and still keep all bolt holes on the gage lines, an adjustment must be made in the position of the holes on the connecting angles. This is called **breaking the gage**. By locating the holes on the outstanding legs at different elevations from those corresponding holes on the web legs, a drafter compensates for the difference in elevation of the connecting beams. Although the holes on the legs of the angles do not line up opposite one another, the holes in the connecting angles will coincide with holes on the gage lines of each of the two beams being connected.

Frequently, the connection angles are noted with a small subscript R or L. This means that the angles are opposite hand.

WORKING DRAWINGS

Definition and Purpose

From this point on, all drawings described are called **working drawings**. The term working drawing is used in all fields of drafting, and the general definition is: "A working drawing is any drawing used to give information for purposes of manufacture, construction, or erection of a machine or structure. Complete knowledge for the production of a machine or structure is given by a set of working drawings conveying all the facts fully and explicitly, so that further instruction is not required." To satisfy this definition, architectural working drawings must include:

1. **Orthographic projection:** The true shape of all features described.
2. **Proper dimensioning:** The true size of all features described.
3. **Call-outs:** Complete notes regarding items not fully described by size and shape.
4. **Construction details, sections:** Enlarged drawings of construction features not completely shown in small-scale drawings or of features which are hidden.
5. **Electrical plan, plumbing plan, heating and ventilating plan, etc.:** Classification of different kinds of information for clarity and completeness of description.
6. **Specifications:** Bid documents, general information, and specific instructions.

In other words, a perfect set of working drawings would contain all the information needed by a builder to complete a building exactly as specified by the architect. In practice, however, continual inspection of the structure is made by the architect, city or county building inspectors, and sometimes the client to ensure compliance with the drawings. Specifications are included in any complete set of working drawings.

Materials and Equipment

On the assumption that students in the class have had at least a year of mechanical drawing before using this book, terms such as **orthographic proejction** and descriptions of objects such as **45 degree triangle** will be omitted from the following discussion on working drawings. Explanation will be made only when terms peculiar to architectural drawing are encountered.

Tools and equipment used by architectural draftsmen:

1. Pencils: Wood or automatic. Weight of lead varies according to individual preference; H to 4H are commonly used.
2. Pencil pointer: Sandpaper or mechanical type.
3. Triangles: Average sizes, 45 degree by 10 in., 30 - 60 degree by 10 in.
4. T square or drafting machine: Both used. This is a matter of personal preference.
5. Scale: Architect's and engineer's.
6. French curves, circle, ellipse, plumbing and electrical templates: To cut drafting time and improve the appearance of the drawing.

7. Erasers, erasing shields, erasing machines, dry cleaner, and brush: For use in correcting mistakes and keeping drawings clean.

SCALING AND DIMENSIONAL PRACTICES

Drawing to Scale

The blueprints used on the job are reproductions of architect's plans and working drawings **drawn to scale**. The idea of drawing objects to scale and reading drawings which are drawn to scale is not new to anyone. Little children draw representations of houses, trees, and animals which are many times larger than the sheets of paper they have to use. As they attempt to draw them in relationship to each other, they are trying to apply a scale to their work.

A road map is a common example of a drawing made to scale. An area of several thousand square miles is shown on a piece of paper only a few square feet in area. It is drawn at a scale of a certain number of miles per inch.

If it were possible to make working drawings of a house at full size and then make blueprints from them, they would be of little use on the construction job because they would be extremely cumbersome. The drawings, therefore, are made small enough so that the blueprints can be handled easily and also large enough so that the blueprints show the necessary information clearly. The length of every line is reduced to a constant fraction of its true length so that all of the parts of the building are in exact relationship to each other. The scale which is usually used for floor plans and elevation drawings is 1/4" = 1'-0". Whenever detailed drawings are required to show the arrangement of doors and drawers of kitchen cabinets, information on the construction of a front entrance doorway, etc., a scale of 1 1/2" = 1' - 0" is often used.

A building which is 32 feet long and 24 feet wide would be drawn as a rectangle 8 inches by 6 inches if 1/4" = 1' - 0" scale were used:

32 X 1/4" = 8"   24 X 1/4" = 6"

Since each one-fourth inch represents 1 foot, 32 feet would be represented by 32 one-fourth inches or 8 inches; and 24 feet would be represented by 24 one-fourth inches or 6 inches. In order to avoid calculating each dimension, the architect uses an **architect's scale** which gives him direct proportional readings in several scales.

The Architect's Scale

The architect's scale used most often in school is triangular with six ruled faces designed to measure in ten different scales. One of the edges is identical to a twelve inch ruler divided into sixteenth's of an inch. (Another type of architect's scale is flat with beveled edges which have only four ruled faces. There is no difference in the scales or in their application. With the triangular scale, however, there are more scales to choose from.)

One of the scales used is designated 1/4 which means that it is intended to be used in making drawings at a scale of 1/4" = 1' - 0". One foot at this scale would be drawn an actual length of 1/4 inch. (Note that 1/4 inch is equal to 1/48 of a foot; therefore, a drawing made with this scale is 1/48 actual size.)

The scale to which a drawing is made is always indicated on the drawing. This scale is generally placed below the title.

Following is a list of the various scales on an architect's scale:

Scale Labeled	**Scale**	**Scale Labeled**	**Scale**
3	3"=1'	3/8	3/8"=1'
1 1/2	1 1/2"=1'	1/4	1/4"=1'
1	1"=1'	3/16	3/16"=1'
3/4	3/4"=1'	1/8	1/8"=1'
1/2	1/2"=1'	3/32	3/32"=1'

Although each of the above scales will be found on most architect's scales, their location may vary on the scales produced by different manufacturers.

Reading a Scale

The 1/4" = 1' - 0" scale is read from right to left beginning with the line marked "0" near the right hand end. From this line, 46 spaces would represent a distance of 46 feet to scale. The 1/8" = 1' - 0" scale is read from left to right beginning with a line marked "0" near the left hand end. From this line 92 spaces to the right would represent a distance of 92 feet at this scale. Thus the same set of markings is used for both the 1/8"=1'-0" scale and the 1/4"=1'-0" scale. It is very important to read the numbers underneath the respective lines in relation to the scale used. Those related to the 1/8" = 1' - 0 " scale are in a row nearest the edge of the scale. Those related to the 1/4" = 1' - 0" scale are in the row farther from the edge of the scale. The lines for the units on this scale have been extended so that this distinction can be made.

When a drawing is made at a scale of 1/8" = 1' - 0" the scale marked 1/8 is used. Whole feet are read to the right of the line marked "0" and parts of a foot are read to the left of the line. The space representing parts of a foot is divided into only six parts because, if it were divided into twelve parts, the spaces would be so small that they would be difficult to distinguish. Each one of the six parts represents 2 inches to scale.

The space used for measuring parts of a foot is divided into twelve parts on both the 1/4" scale and the 3/16" scale. Each space represents one inch. The 1/2" scale and the 3/4" scale are different in that the space is divided into 12 parts but each one is again divided in half. The smallest unit then represents one-half inch. Thus it is possible to measure spaces representing inches and also half inches.

Using Folding Rule to Draw to Scale and to Read Dimensions

A folding rule or any ruler divided into inches and 1/16's of an inch may be used to make drawings and to read drawings at 1/4" = 1' - 0" scale. It must be stressed however that the results will not be perfectly accurate because the small divisions shown on the architect's scale are not available. Also, blueprints should be measured only as a last resort after every other means of obtaining the required dimension has been exhausted.

Occasionally a crafsman finds it necessary to make a sketch on the job to scale. This may be done in order to work out a problem, or to transmit information back to his shop or to the architect. The ability to use a folding rule as a device to make meaningful sketches will prove to be valuable.

Each 1/4 inch space on the folding rule is considered to be 1 foot on the sketch or blueprint. Each 1/16 inch space on the folding rule is considered to be 3 inches. Thus a distance of 1 3/16" would represent 4'9" at the scale of 1/4" = 1'-0". It is necessary to count the number of 1/4 inch spaces to find the number of feet and add the number of 1/16" spaces giving each one the value of 3 inches.

Measuring Blueprints to Obtain Dimensions

Even though it is possible to measure blueprints with an architect's scale or folding rule to obtain missing dimensions, this practice should be used only if every other means has been used first. Blueprints are reproductions of original drawings and in the reproduction process a slight amount of shrinkage may occur. With the new diazo processes, this is negligible. However, a problem may develop in that the part of the drawing to be measured may not be drawn to scale. Architects do everything they can to draw the plans exactly to scale. Occasionally last minute changes are made which would mean completely redrawing the plans in order to have them exactly to scale. If the work must go ahead without taking this additional time, only the dimensions may be changed rather than doing all of the drafting work over again. When one dimension is changed usually it affects one or more other dimensions.

All the necessary dimensions are generally included on the blueprints. Sometimes it takes study to find them. They may be somewhere else on the same view or on one of the other blueprints in the set. Occasionally it is necessary to do a little arithmetic to find the information.

The over-all length of the house would only be shown on one of the sides. Heights of similar windows above the floor would be shown once on an elevation view. A series of dimensions locating partitions may be shown on one line across a floor plan. If partitions continue across the building from wall to wall, it is unnecessary to show the same dimensions in other rooms.

It may be necessary to look at several blueprints in order to find a desired dimension. A sectional view through an exterior wall, for example, may show dimensions which are required when working on the exterior of the house and which might otherwise appear on elevation views.

Some dimensions are obtained by simple arithmetic, find a missing dimension when all but one dimension in a series are given. By adding the three dimensions given and subtracting them from the overall dimension, the distance from A to B can be obtained.

6'-6"
6'-3"
6'-6"
18'-15" or 19'-3"

26'-0' = 25'-12"
-19'- 3"
6'- 9"

The measurement from A to B should be 6'-9".

Drawing Symbols and Conventions to Scale

Every symbol or convention used on elevation or plan views is, as nearly as possible, drawn accurately to scale. In other words walls, windows, doors, plumbing and other fixtures, footings, partitions, chimneys, roofs, etc., are all drawn in proportion to their size, following whichever of the various scales is being employed. Thus, if a wall is to be drawn 6 inches thick on a drawing which is drawn at 1/4" = 1'-0" scale, the architect will draw the parallel lines of the wall symbol 6 inches apart to scale. Using a folding rule to scale the blueprint of the drawing, it would measure 1/8" (at 1/4" = 1'-0" scale, 1/8" = 6 inches).

Bathroom fixtures are drawn to scaled sizes and located so that they fit into the space provided for them. Windows, doors, and all of the parts of the building are drawn to scale both on the plan and elevation views.

THE PLOT PLAN

The plot plan is usually shown on the first sheet of a set of blueprints. It shows the shape of the lot on which the building is to be built, the lot dimensions, and the angles at each corner. The dimensions of each building already built on the lot and those to be built are shown, and dimensions are given locating them in relation to the property lines. The location of walks, drives, courts, patios, etc., are given. An arrow indicating the north point is included. Utilities such as gas mains and electric power source are shown. Water mains, and sewers are identified with a line symbol. The relationship of levels (elevations) at various points on the lot and the first floor level (elevation) of new buildings are indicated. Contour lines show the *natural* slope of the ground. A second set of contour lines shows the slope *after* the fill has been redistributed and the construction is completed. Existing trees and shrubs are usually shown, and those which are to be removed are designated.

The local building authorities require that a plot plan be submitted to them so that they may determine quickly whether or not the ratio of the area of the house to the area of the lot, and the location of the house on the lot, follow the building ordinances. For instance, some communities do not permit a single family dwelling to cover more than 30 per cent of the area of the lot. Also, the distance form the side building line to the property line may not be less than five feet. Other cities may require this distance to be 10 per cent of the width of the lot. Buildings in a block must remain back of a building line established by the city. The building on the corner lot has an area of 1440 square feet not including the garage. The lot has an area of 7200 square feet. Thus the house only covers 20% of the area of the lot. This should be quite satisfactory. Dimensions from property lines to building lines are usually established by the city. Minimum dimensions between houses are often established but may vary depending on the type of structure, number of floors in the houses, etc. Minimum side limits are specified regardless of other factors. Minimum side and rear yard limits may be set also. Each town and city has its own requirements regarding area and placement limits.

Restrictions are placed on buildings in relation to the lots on which they are to be built in order:

> To provide for (a) convenient access to and circulation around the dwelling, (b) adequate natural light and ventilation of rooms and spaces, (c) reasonable privacy for each living unit, (d) utilization of the plot for laundry drying, gardening, landscaping and outdoor living, (e) and where individual water-supply and sewage-disposal systems are involved, adequate areas to assure a safe and sanitary installation.[1]

The Survey Plat

The basic information for the plot plan is found on a survey plat which is drawn by a licensed surveyor. He obtains the legal descriptions of the piece of ground from the deed to the property which he receives from the owner. Using his surveying instruments and a tape or chain he located a corner of the property in reference to a *Datum Point* which has been established by the town, city, or county. This is usually a marker made of concrete and embedded in the ground, or it may be any other point which is designated by ordinance to serve the purpose. In a city, the marker may be placed on a street or a walk. It could even be a notch on the corner of a building. When a new subdivision is opened the surveyor may have to establish accurate direction lines, measure precise distance, and work out differences in level (elevation) from a *Datum Point* which is far away. After the surveyor locates a corner of the property or some central point, a stake is driven firmly in place or a concrete bench mark is set. This in turn becomes the point of reference for the location of streets and lots in the new community.

When a surveyor makes a survey of a lot the first thing he does is to establish a *point of beginning* which may be a mark on a walk or a corner stake. This point serves to help him locate the other corners of the piece of ground and also to relate levels (elevations) to the city requirements for that particular lot.

The surveyor shows much other information on his plat besides the location of the lot corners. He also indicates the location of utilities, and water and sewer mains. Unless the lot is almost flat he shows the contour of the lot by using a series of contour lines at a uniform interval of levels or grades. He shows trees, walks, and streets on his drawing. A surveyor's plat is usually required by banks and other lending institutions before mortgages for building can be arranged.

Scale Used by the Surveyor

A surveyor uses a tape or chain, and a leveling rod graduated in feet and tenths of a foot. He makes his drawing using a scale of 1"=10' or 1"=20'.

A dimension of 120.5 would mean 120 and 5/10 feet or 120 feet and 6 inches. A dimension of 65.7' would mean 65 and 7/10 feet. In order to convert 7/10 of a foot to inches the following process is used:

$$7/10 \times 12" = 84"/10$$

84"/10 = 8.4 inches or almost 8 1/2 inches. For practical purposes in laying out a lot or a building, the dimension used by a craftsman would be 65'-8 1/2". (To be more accurate, the Decimal Equivalent Table in the appendix indicates that .4 inches is closer to 3/8 of an inch.)

The elevation of the corners of the lot as 112, 108, 111.2 and 114.9 feet. The latter two elevations would be approximately 111'-2 1/2" and 114'-10 3/4".

Elevations

The height of any point on the lot is called its *elevation* and is measured above or below some point of reference. (The use of the word elevation in this sense must not be confused with the elevation of a house which is a view of the outside of the structure.) The elevation of the point of beginning is 112 feet. This means that the level of this point is 112 feet above the point of reference used in that community. It may be above sea level, above mean lake level if there is a large body of water nearby, or it may be above some fixed point on a street or building. The elevation of all other points on the lot are measured by using a transit and a leveling rod in reference to the datum point.

Contour Lines

Contour lines are lines drawn on a surveyor's plat or on an architect's plot plan to show the slope of the ground. A contour line may be explained by thinking of the lowest contour line as the shore of the lake. If the water were to rise one foot the shore line (contour line) would take a new shape as the water covered more of the earth. The intervals of contour lines on small lots are usually in units of one foot elevations. If the tracts are large or very hilly, contour lines may be in two foot or larger units.

The Plot Plan

The architect uses the information supplied by the surveyor's plat in drawing the plot plan. He draws the lot accurately, usually converting the dimensions from feet and decimals of a foot to feet and inches. He indicates the north point, the lot and block number, the datum point, or point of beginning taken from a local city measuring point, and locates utilities, sewers, streets, and public walks. He then locates the house, making sure that he has observed all of the area restrictions, front and side limitations, etc., established by local ordinances. He draws the contour lines showing the natural grade elevations. He then draws a second set of contour lines to show how the lot is to be sloped after the project is completed. These lines will determine the finish grade.

The level of the point of beginning given by the surveyor is designated, and the first floor is indicated so the excavator may know how deep to dig the hole for the foundation.

In the plot plan, the architect established the first floor level at 114'-0" in direct reference to the datum point. When a plan may be used more than once on different lots, the elevation of the first floor is often shown as ±0'-0".

When tall buildings are built each floor is designated by an elevation. The architect may use city datum information as a base. The first floor level is 2'-0" above the natural grade which makes it 115'-0". The basement floor level is 6'-0" below the natural grade which makes it 107'-0".

The architect has the option to establish the level of the first floor at 100'-0" in order to make measurements for other floor levels easier to determine. The first floor must first be established in proper relation to the natural grade. Then the level of the finished grade is changed to the correct relationship to the first floor level.

Each of the last three chapters in this manual includes an almost complete set of building plans that is intended for practice in learning to read architectural working drawings. One or two sections of the specifications for each building are also included to help you understand the relationship between the drawings and the specifications. A discussion of the sets of plans is included in the next three chapters as well as relevant tests to help you gain an understanding of architectural working drawings. Presented for study is a one-story bearing-wall and steel-frame building, a three-story steel-frame building, and a reinforced-concrete building.

The actual drawings (which were 24" X 36" X 30" X42") have been reduced in size to fit in this manual and some of the original drawings had to be left out. However, many of the details, shown on the omitted drawings, have been added to the drawings presented so that all essential details are included for a thorough understanding of the plans for each building. Because they were added on various drawings, wherever space was available, you will find a discontinuity in the reference system for some of the details that are shown on several of the drawings.

USE THIS PROCEDURE WHEN READING COMMERCIAL BUILDING DRAWINGS

In general, follow the points listed next in orienting yourself to any set of drawings that is unfamiliar to you. Keep in mind that drawings must be interpreted together and that they should not be take as isolated sheets of information.

Get a General Impression of the Building

First, look over the site plan and the building elevations to create a preliminary mental image of the shape and size of the building. Look for the north arrow on the site plan so that the elevations can be related to the plan view. Some sets of drawings include a perspective view of the building on the cover sheet. When this is the case, relate the elevations to the perspective. Then, try to relate the elevations to the floor plan, and orient yourself to the front entrance where the main traffic will enter. Generally, the floor plan is placed with its front facing the lower edge of the sheet, but this procedure is not always followed. Concern yourself with the exterior features first. Notice the materials used and where they appear. Look for irregular features on the elevations so that you can identify them on the plan and be positive of the orientation. Study the roof plan and notice the direction of the drainage. Of course, remember the purpose of the building and look for those features that you associate with this type of building.

Locate and Identify the "Bones" of the Structure

Study the longitudinal and/or transverse sections through the building. To orient these sections correctly, you may need to examine the plans again, since a building that is almost square in plan makes it questionable as to which is transverse and which is longitudinal. These sections are usually found on the architectural drawings, but the structural sheets will sometimes have full building sections. See if you can determine the structural system being used. If these complete sections are not included, look at the typical wall sections. Turn to the structural sheets to see where columns, girders, beams, etc., are located. You should try to visualize the skeleton that supports the building and its components. The foundation plan will show where columns and walls are placed. Look for grid and reference lines on both the architectural and structural sheets. In most cases, the skeleton members are associated with the reference lines. Try to understand where horizontal members, shown in sections, are supported and how their loads are transferred to columns or bearing walls.

Identify Unusual Drafting Techniques Employed by the Drafter to Show Information

You will find that working drawings done by different offices often vary somewhat in the way in which drawings, notes, and schedules are presented, even though a great deal of standardization exists in the industry. You will find differences on the drawings in the chapters that follow. Observing how these minor variations appear is a part of interpreting the drawings. Notice how leaders relate notes to features, how titles are arranged, and how cutting-plane lines and symbols are used to show the locations of sections. Examine the schedules and observe how they are used and the items that are covered by schedules. Structural, mechanical, and electrical drawings, usually prepared in separate offices, are especially noted for the way minor points are handled differently in comparison with the architectural drawings. Some symbols and abbreviations, too, vary with offices (and with drafters) and are sometimes troublesome for the novice.

Relate Sections and Construction Details to the Larger Views

Notice how sections and details are used to make the information shown on the plans and elevations understandable to the builder and how they identify the various items and materials necessary for construction. After you understand the labeling system employed throughout the drawings, relate the details to their position on the plans or elevations. Reference to various drawings may be necessary before this can be accomplished. Some sections, of course, are labeled as "typical" and have no definite cutting planes, but you should try to identify where, and to what extent, the typical construction applies. Some walls or parts of walls, for example, usually vary from the typical condition, and other specific details may (or may not) be included to explain the variation. It is always helpful to refer back to the longitudinal and transverse sections to relate these specific details to the building as a whole. You may need to examine the plans and elevations again to orient these details correctly and to determine their meaning.

Determine How the Mechanical Equipment, Plumbing, and Electrical Wiring Are Related to the Building

Look for the type of heating and cooling system being employed and how the ductwork fits into the structure. Most often the ducts are concealed above the ceiling, and diffusers are used to conduct the treated air to the spaces of the building. Air-handling units are frequently found on the roof, and the structural drawings then usually show extra supports to carry the weight of these units. Many times the reasons for lower ceiling heights in an area will be found on the mechanical drawings. While plumbing plans will show the domestic water lines and the sanitary sewer lines and vents, they will also frequently show the handling of the rainwater that falls on the roof.

Schedules on these drawings and particularly on the electrical drawings show the kind of equipment and lighting fixtures used in the building. The locations of switches and panel boxes identify places where conduit must be run and sometimes reveal why walls are shaped in an odd way or why structural and other building components are present in some areas.

READING FLOOR PLANS

Importance of Floor Plans

The building tradesman finds it to his advantage to be able to read blueprints of floor plans very early in his job experience. When he acquires this ability, he becomes part of a team representing many skills working out a series of construction problems together. He must know how to "take off" dimensions accurately so that all of the partitions, windows, and doors are located according to the blueprints. He must learn to recognize the symbols representing material, equipment and fixtures, and to interpret abbreviations and understand notations. He should know about information intended for trades other than his own. Almost every trade is inter-related to some extent, and all tradesmen must follow the prints carefully if the work is to progress smoothly.

When an experienced builder gets a new set of blueprints to study, he spends some time becoming familiar with the layout, paying little or no attention to the maze of information usually found on them. The broad aspects of shape, size and relationship of rooms, and the use of auxiliary space such as hallways, stairs, and closets are of primary importance.

The process of learning to visualize how a house is laid out requires this type of simplification. Sometimes a blueprint is so complex that it is advisable to place a piece of tracing paper over it and to trace the walls, partitions, and openings, omitting all other information. This procedure will provide a sketch showing the relationship between areas which is comparatively easy to read. Some imagination must be used in studying floor plans. The builder should try to visualize what he would see as he entered the front door of the building.

In planning a building, the greatest emphasis is put on the floor plans. An architect generally feels that if the floor plans are good, the elevations will be relatively easy to work out. (This is not always true because special problems may arise anywhere.) In learning to read blueprints the greatest emphasis, therefore, should be made on studying floor plans because the floor plans are of primary importance.

Basic Ideas in Reading Floor Plans

The following things are basic to reading blueprints of plan views.

1. Floor plan views are drawn to exact scale. The rooms, hallways, cabinets, stairs, etc., are drawn so that they are in correct relationship to one another.

2. The floor plan views and elevations are drawn to the same scale and are exactly related to each other. Windows which appear on the floor plan views are the same size and the same distance from the building corners as they are on the elevation views. By referring back and forth from floor plan views to elevation views it should become relatively easy to visualize the whole building.

3. Floor plan views are related to each other. Structural provisions are made so that the load of floors and partitions are transferred to supporting members or partitions immediately below. Stairs are designed so that they start on one floor and end in the right place on the floor above or below. Provision is made so that heating ducts may start at the furnace, pass through first floor partitions, and end at registers in the desired location in second floor partitions.

It is generally considered good practice not to show the same information in two separate plans.

Openings

Blueprints of elevation drawings show a great deal about windows, doors, and other openings. Reference must be made to the blueprints of floor plans to find horizontal locating dimensions.

The elevations show the windows as they appear in the wall in their exact location. The window types most frequently used are fixed sash, double hung, horizontal sliding (gliding), casement, awning, and hopper. The elevation views show how the sash is divided and where the hinges are located on a sash which swings in or out. The apex of a triangle drawn on a window points to the side with the hinges. The size of the light (pane of glass) may also be shown. If a sash of a window contained a designation 28/24, this would mean that the glass size is 28 inches wide and 24 inches high.

Doors are indicated on blueprints of elevation drawings in their proper location and their particular style is shown. The symbol for a flush door is a plain rectangle unless it has a light (glass). A panel door is drawn to show the panel and light arrangement.

The lock and hinges are usually omitted. The floor plan shows how the door swings. The builder refers to the floor plan to find out on which side of the door to install the lock and on which side to install the hinges.

Other openings, such as screened vents, louvers, etc., will be drawn in place and designated with whatever notes are deemed necessary.

Dimensions

Several important functions of elevation views are to establish floor levels, to relate these levels to the finished grade, and to supply dimensions which would not appear elsewhere on the set of blueprints. The floor levels drawn on the elevations help the builder visualize the relationship between windows, and floor and ceiling levels. This information may also appear on a blueprint which shows a vertical wall section.

Exterior Finish-Materials

The elevation views show by means of symbols and notations what type of material is used on the outside of the house. Siding of several shapes, widths, and materials is often required. Plywood sheets serve as exterior wall covering and are used in a variety of ways. Shingles of wood, asbestos cement, and asphalt composition, as well as stucco, give several interesting effects. Masonry of brick, stone, or concrete blocks serve structural purposes and serve as wall facing. A veneer of brick or stone has proved to be very satisfactory in many regions.

Exterior Finish-Trim

The elevation views also show decorative features designed to enhance the appearance of the building such as an entrance doorway, a ballustrade, columns or posts, decorative trim around windows, and the cornice at the eaves.

Miscellaneous Details

A number of other things may be shown on the blueprints of the elevations to alert the builder to the location of specific items. Electric utility outlets and fixtures are indicated at their proper places and at the approximate height desired. Gutters at the eaves and downspouts (sometimes called leaders) are drawn in place, and flashing (metal strips) is shown at chimneys and other places where water might find its way between masonry and wood members. Hose bibbs may be shown but are more usually indicated on the plan views only.

READING ELEVATION DRAWINGS

An elevation drawing is an orthographic projection showing the exterior view of one side of a building. (An elevation drawing may be made of an interior wall or feature of a building, but for the purpose of this chapter the elevations are all considered to be exterior views.) The four elevations, each showing a side of the structure, are part of the working drawings prepared by the architect and serve to indicate what the building will look like when it is completed. Their function is to show the design of the building where the openings are to be placed, what materials are to be used, etc.

It is important to understand how the blueprints of a set of working drawings are related to each other and why it is often necessary to refer to several of them in order to find all of the information on one subject. The original drawings are carefully drawn by the architect so that foundation plan, floor plans, and the elvations exactly match regarding the location of windows, doors, and other details. For instance, to find out about a particular window it is necessary to look at the blueprint of the floor plan to find out the exact dimension from the corner of the house to the window. An elevation view shows what the window looks like and where it is located vertically in the wall. The size of the window may appear on the elevation drawing but it may also be found on a window schedule on some other blueprint. Ample opportunity will be given to work with this relationship between the floor plan and elevation blueprints in a later chapter.

The architect shows much of the information on elevation drawings by using symbols and abbreviations. The reason for using these shortcuts is due to the fact that the drawings are usually made at 1/48th the size of the building (1/4" = 1'-0"). To show all of the lines which appear on the finished building and to spell out each designation would be impossible. A sort of shorthand of lines and symbols has been adopted by architects so that plans may show the necessary information to the builder without becoming so complex that they would be difficult to read.

332

The same is true of abbreviations. Architects have devised abbreviations which have become accepted in the industry and which are used to designate the many things which appear on the blueprints. The readability of the blueprint is preserved because there is some space left not covered by notations.

A set of specifications accompanies each set of blueprints. The specifications give general information about the legal aspects of responsibility, guarantees of performance, etc. Following the general information sections, the specifications describe the responsibility of each subcontractor as to what work is to be done and what materials are to be used.

Information to be Found on Elevation Drawings

This is a broad checklist. Mark the terms which are new to you for further study.

Design of the Building.
- General shape. Locations of offsets, ells, patios, steps, porches, bays, dormers, chimneys, etc.
- Information on footings and foundations.

The Roof.
- Type and slope of roof.
- Roofing material.
- Vents, gravel stop, projection of eaves.

Openings.
- Windows-types, sizes, swing, location in wall.
- Doors-types, sizes, location in wall.

Dimensions.
- Dimension from established grade to finished first floor level.
- Dimension from established grade to finished basement floor level.
- Floor to floor heights.
- Heights of special windows above floor.
- Dimension from ridge to top of chimney.

Exterior Finish-Material.
- Types of wood or composition siding, shingles, etc.
- Concrete, concrete block, brick, stone, stucco, etc.

Exterior Finish-Trim.
- Decorative treatment at:
  - Windows.
  - Entrance doorways.
  - Columns, posts, ballustrades.
  - Cornices.

Miscellaneous Details.

Electrical fixtures and utility outlets.
Gutters and downspouts.
Flashing and waterproofing.

Design of the Building

A house is generally designed from the inside out. In other words, the floor plans are considered first because they will determine the arrangement and size of the various space divisions. The exterior of the house is no less important because it reflects the good planning used inside and makes the house a thing of beauty outside. Often an architect is expected to design a building in a particular style. The details of design, such as the general proportions, the roof, type of windows and trim, must be in keeping with the style. As the student reads the blueprints he must learn how to distinguish the parts of the building by looking at the elevations. Whenever a change is shown in a wall or roof line it indicates some modification of the rectangular shape. After studying several sets of plans, he should be able to see from the elevations, with only a quick reference to the first floor plan, whether the building is "L," "U" or "T" shaped or has an enclosed court. Other elements of the building such as bays, dormers, and chimneys should be studied by looking at two related elevations so that the front and side views may be observed.

The part of the building under the established grade (ground level) is shown with hidden (dashed) lines. This includes footings (the foundation base), foundation walls, and windows and areaways below grade related to that particular side of the house. There is no other blueprint in the set where this information could be shown as suitably.

READING BLUEPRINTS FOR STRUCTURAL INFORMATION

When an architect draws the plans for a large structure, such as an office building or a factory, he has several specially trained men to help him. One of them is an architectural engineer or structural engineer who will draw structural plans to accompany the architectural plans, giving important information about the foundation, the skeleton, and the floor system. The size and location of each steel member will be indicated for each floos; or a complete layout of the reinforcing steel will be drawn if the building is to be made of concrete. Still other drawings called shop drawings will be made by the contractor which will show the men in the shop how the individual pieces are to be prepared for fabrication and how they should be assembled.

The blueprints which are made from the set of structural drawings are the source of information for the craftsman working on a large structure. However, this is not the case for the craftsman in the field of home building.

In home building the craftsman must learn how to read a set of blueprints and a set of specifications. From this meager information he should be able to visualize the whole framework of the house. He must be able to lay out the building lines so that the foundation is set in the right place on the lot, and he must determine the grade so that the building will be at the proper height in relation to the established point of measure. His next job is to erect forms so that the foundation, when it is poured, will have the exact dimensions required for the house. He must be able to visualize the supporting members for the floor and to place openings for stairwells and chimneys in the right places. He must plan the walls and partitions in detail, placing the openings in the correct locations and providing for window and door frames with necessary allowances for fitting.

The construction of the roof is usually left to the craftsman with little guidance other than the blueprints of the elevation views and plan views. He must visualize the general shape and then must measure and cut the many members which will serve to support the roof. All of the members used in the building must be made structurally sound. Provisions must be made for wind stress and snow load, depending on the region.

Thus blueprint reading is much more than merely reading the prints. It becomes a matter of interpreting them in terms of members of wood and units of concrete, brick, stone, glass, and other materials not shown in detail on the blueprints.

In order to build a house from a set of blueprints, a great deal of information on the details of construction must be mastered. It is beyond the scope of this book or any one book to give this subject thorough treatment because of the great amount of technical information needed and the many variations between buildings. Many good textbooks are available on carpentry and masonry construction as well as on heating, plumbing, and the other trade industries.

READING DETAIL DRAWINGS

The architect tries to show, on the plan views and the elevation views, all of the graphical information required to build a building. (Specifications give additional information in the form of written explanations and descriptions.) However, almost every time the architect draws a set of plans, he finds it necessary to show some part which does not ordinarily appear on the plans and elevations in detail. He finds it necessary to show some features at a larger scale because enough information cannot be crowded into the space of the small scale drawings. Some of the details are sectional views taken through a part of the building, such as a fireplace or a foundation wall, to show construction and dimensions.

When an architect prepares drawings for a large building, he assembles what is called an architectural set of plans which contains floor plans, elevations, section drawings, and as many details as necessary to enable the various contractors to prepare estimates. After the contracts are let, detail drawings, often numbering several hundred, are prepared to show items of construction, elevations of rooms, full size details of ornamentation and trim, etc. It is understood that the details may not alter the basic information given on the architect's original plans. Their purpose is to clarify the many things which could not be drawn earlier because of lack of time.

The types of details which are shown on a set of blueprints of a small home generally fall into these classes:

A. Elevations of kitchens, bathrooms, and walls in other rooms which have some special features. These ar generally drawn at the same scale as the floor plans unless they are very complex.

B. Sectional views through parts of the building, such as through a fireplace or through the foundation at various places. Structural information to show how floor members should be placed at a stairwell or to show how a truss is to be constructed.

C. Details of windows and doors. Views showing how special frames are to be made for bay windows or other unusual arrangements of windows.

D. Details of exterior trim such as cornices, dormers, front entrance doorways, etc. Details of interior trim such as built-in cabinets, mantels, paneling, and trim.

The Scale Used for Details

Detail views may be drawn at the same scale as the plan views (usually 1/4" = 1'-0")if they are not too complex. The use of the same scale is particularly applicable to the drawing of room elevations. This allows dimensions to be transferred directly from plan views to the elevations. construction details are usually drawn at a larger scale so that they can be shown with greater clarity.

The architect may choose one of several scales, depending primarily on how large the detail must be drawn in order to show all of the information clearly. A second consideration, of course, is the amount of space available on the sheet. The scales preferred are:

3/4" = 1'-0"

1 1/2 " = 1'-0"

3" = 1'-0"

FULL SIZE

Scales of 1/2" = 1'-0" are not considered the best practice.

The reason for using the scales suggested above is that the builder who is to use the blueprints carries a folding rule divided into inches and sixteenths of an inch. If the detail were drawn at the scale of 3/4" = 1' -0", each 1/16 inch on his rule would represent one inch. If the detail were drawn at a scale of 1 1/2" = 1' -0", each 1/8 inch would represent one inch. If the detail were drawn at the scale of 3" = 1' -0", each 1/4 inch on his rule would represent 1/4 inch. A drawing made at the scale of 3" = 1' -0" is one fourth actual size. Full size details are drawn when the exact shape of a molding, parts of a curved stair rail, etc., are required.

Dimensions

Dimensions are shown on detail views if they are not shown elsewhere on the plans and elevations or if they add greatly to the understanding of the view. It is important that there be control over dimensioning in general. When the same dimension is shown on two different views, confusion would result if one were changed and the other were not. When dimensions are shown only once, it may be necessary to refer to several blueprints in order to find a desired dimension.

Locating the Detail

In many instances it is necessary to show the exact place where the section view is taken and the direction in which the imaginary slice is viewed. This is accomplished by drawing a cutting plane line through the plan or elevation view with two arrows showing the direction the reader is to look to see the detail.

A notation SEE DETAIL is frequently used to call attention to the fact that more information is obtainable about the designated part of the building somewhere else on the same sheet or on another sheet of the set of blueprints. Wherever there are several details, they will be designated DETAIL 1, DETAIL 2, etc. When several sectional views are taken through walls, foundations, or other parts of the structure, the section drawings are designated SECTION A-A, SECTION B-B, etc.

Whenever a detail is drawn it should be placed on the same drawing where reference is made to it, if at all possible. Occassionally all of the details are gathered together on one sheet.

Details of Interior Wall Elevations

The plan view of a kitchen shows the location of cabinets, sink, dishwasher, and all permanent built-in features. It also shows where space is provided for movable equipment such as the refrigerator and range. This information is not sufficient for the millman who makes the cabinets or for the carpenter who must build the soffit over the cabinets. (A soffit in this sense is a lowered ceiling.) Elevation views are necessary to show the arrangement of cabinet doors and drawers and to give information about soffits, lighting, hoods, fans, and many other features.

Cabinets are often built to order to fit perfectly into the space provided. Dimensions of the cabinets, except for height dimensions, are not usually shown on the detail elevation views. However, the millman measures the space carefully and then proceeds to make the cabinets to fit. He studies the detail drawings in order to use the desired arrangement of doors and drawers. He makes the counter top, cutting out the pieces, where the sink and range top will fall into place. When stock cabinets are used, adjustments are made by the use of fillers so that cabinets will fill the whole wall space. A typical modern kitchen with a counter top range and a built-in oven shows how the detailed elevation views of a kitchen look on a blueprint.

Bathroom elevation views are generally shown in detail also. The location of the fixtures is obtained from the plan view. The plan view is inadequate to show all of the features of the bathroom unless elevation views or extensive notes are provided. The elevations tell the prospective owner at a glance how the room will look. They will give the builder important information about features, such as a dropped ceiling over the tub. They will also indicate details about drawers, the mirror, and lighting for a cabinet-lavatory. They may show the location of accessories such as towel bars, soap dishes, etc.

Many times the walls of other rooms have special treatments which would make it advisable to draw them in detail. Such instances might be wood paneling and fireplace arrangements, built-in features such as chests of drawers in dining rooms, or book shelves in library or living room.

GLOSSARY

GLOSSARY

ACCEPTED BID The bid proposal accepted by the owner, or his or her representative, as the basis of a contract for the proposed curriculum.

ACCESS Location of opening at which concealed equipment may be reached for inspection or repair.

ACCESS BOX Rust-resistant metal box with hinged cover, allowing access to a device or cleanout; usually set flush with floor.

ACI American Concrete Institute; source for most specifications on concrete construction.

ACOUSTIC TILE Tile, made in a variety of sizes, that is applied to ceilings and walls for the purpose of absorbing and deadening sound within spaces of buildings; also used to obtain optimum reverberation time in auditoriums.

ACOUSTICS The science of sound and sound control.

ACRE Unit for measuring land; equal to 43,560 square feet.

ACTIVE LEAF The door leaf of a pair in which the lock is normally installed.

ADDENDUM (ADDENDA) Drawn or written information, issued prior to the opening of bids, that modifies or interprets the bid documents (drawings and/or specifications).

ADDITION The construction, or proposed construction, of an extension or increase in floor area or height of a building or structure.

ADMIXTURES Substances used in cements, mortars, and concretes for the purpose of imparting particular properties such as to improve workability and durability, to accelerate or retard setting, to reduce bleeding, or to add color.

AGGREGATE Stone, gravel, cinder, or slag used as one of the components of concrete.

AIA American Institute of Architects; source for many contract document forms.

AIR CHANGES In ventilation, the number of times the air is changed per hour in a room.

AIR-DRIED LUMBER Lumber that has been stored in yards or sheds for a period of time after cutting. Building codes typically assume a 19 percent moisture content when determining joist and beams of air-dried lumber.

AIR DUCT A pipe, typically made of sheet metal, that carries air from a source such as a furnace or air conditioner to a room within a structure.

AIR-ENTRAINED CONCRETE Concrete containing minute bubbles of air (up to approximately 7 percent by volume); produced by adding air-entraining admixtures; improves concrete workability and durability.

AIR VENT VALVE An escape valve for air at high points in a hot-water heating system.

AISC American Institute of Steel Construction; source for most specifications on steel construction.

ALLEY Any public space or thoroughfare 20 feet or less in width that has been dedicated to public use.

AMPACITY A wire's ability to carry current safely, without undue heating.

ANCHOR BOLT A metal bolt used to tie down a wood sill to a masonry or concrete foundation wall.

ANCHORS Irons of special shape used to fasten masonry and wood parts together.

ANGLE (ANGLE IRON) A piece of structural iron formed with the cross section shape of a right angle.

ANSI American National Standards Institute; source for many specifications used in design and construction.

APRON The inside trim board placed below a window sill. The term is also used to apply to a curb around a driveway or parking area.

AREA, BUILDING The maximum area of a building, projected on the horizontal, at or above grade, exclusive of areas open and unobstructed to the sky; usually expressed in square feet.

AREA, GROSS FLOOR The area within the inside perimeter of the exterior walls of a building, with no deduction for corridors, stairs, closets, thickness of walls, columns, or other features and exclusive of open areas; usually expressed in square feet.

AREAWAY An opening adjacent to a basement window or door to permit air and light to enter.

ASBESTOS A mineral that does not burn or conduct heat; it is usually used for roofing material.

ASH DROP (OR ASH DUMP) A trap door for ashes in the floor of the fireplace leading to a chute.

ASH PIT An area in the bottom of the firebox of a fireplace to collect ash.

ASHLAR MASONRY Squared masonry units laid with a horizontal bed joint.

ASPHALT An insoluble material used for making floor tile and for waterproofing walls and roofs.

ASPHALTIC CONCRETE A mixture of asphalt and aggregate which is used for driveways.
ASTM American Society for Testing Materials; usually followed by a designation indicating a particular test procedure, such as ASTM E136.

ASTRAGAL A vertical molding attached to the meeting edge of one leaf of a pair of doors for protection against weather conditions and to retard passage of smoke, flame and gasses.

ATRIUM An inside courtyard of a structure which may be either open at the top or covered with a roof.

ATTIC The area formed between the ceiling joists and rafters.

AWG American Wire Gauge; the standard electrical wire size measuring system in the United States.

AWNING WINDOW A window that is hinged along the top edge.

AXIAL LOAD Load applied down the center of gravity of a structural member; usually refers to a load considered to be acting at the centroid of a column cross section.

BACKFILL Earth, gravel, or sand placed in the trench around the footing and stem wall after the foundation has cured.

BAND JOIST A joist set at the edge of the structure that runs parallel to the other joist. Also called a rim joist.

BANISTER A handrail beside a stairway.

BAR JOISTS See open web joists.

BARRIER SCREEN See Smoke Screen.

BASE SHOE A small molding applied to the baseboard at the floor.

BASEBOARD A finish board covering the wall where it meets the floor.

BATT INSULATION Blanket insulation cut into short lengths to make it easy to handle and apply.

BATTEN A narrow strip of wood used to cover the joint between two vertical pieces of siding.

BATTERBOARD A construction of stakes and horizontal boards from which chalk lines are hung which define the building lines.

BAY Square or rectangular area, usually in a uniform grouping, surrounded by columns.

BAY WINDOW A window projecting outward from the face of a wall.

BEAM Load-carrying structural member spanning between two or more supports; usually supporting secondary structural members such as floors, roofs, and joists.

BEAM REACTIONS The forces at the supports of a beam caused by (or as a reaction to) the loading on the beam.

BEARING PLATE A support member, often a steel plate used to spread weight over a larger area.

BEARING WALL A wall supporting any vertical load in addition to its weight.

BELLED PILE Pile with a flared bottom for better bearing support.

BENCH MARK A mark on some object firmly fixed in the ground from which distances and elevations are measured.

BENDING MOMENT The internal resistance of a beam to bending. The application of a load causes the beam cross section to rotate about its neutral axis and therefore to bend. The resistance to this rotation is termed bending moment (sometimes call moment). Measured in ft-lb, inch-lb, ft-kips, or newtons (N) (metric).

BEVELED EDGE The edge at a door that is not at a 90 degree angle to the face of the door (std. bevel is 1/8" in 2").

BEVELED SIDING Siding that has a tapered thickness.

BIBB An outdoor faucet which is threaded so that a hose may be attached.

BIRD BLOCK A block placed between rafters to maintain a uniform spacing and to keep animals out of the attic.

BIRD'S MOUTH A notch cut into a rafter to provide a bearing surface where the rafter intersects the top plat.

BLANK JAMB Vertical member of frame without hardware preparation. Used when doors are furnished with push and pull hardware or surface mounted strikes and single active floor hinges.

BLEEDING In concrete, the appearance of excess water rising to the surface shortly after placing of concrete.

BLIND NAILING Driving nails in such a way that the heads are concealed from view.

BLOCKING framing members, typically wood, placed between joist, rafters, or studs to provide rigidity. Also called bridging.

BOARD AND BATTEN A type of siding using vertical boards with small wood strips (battens) used to cover the joints of the boards.

BOARD FOOT The amount of wood contained in a piece of lumber 1 inch thick by 12 inches wide by 12 inches long.

BOILER A unit that produces hot water or steam for heating.

BOND BEAM A reinforced concrete beam used to strengthen masonry walls.

BOND The mortar joint between two masonry units, or a pattern in which masonry units are arranged.

BORROWED LIGHT Four-sided frame prepared for glass installation in field.

BOTTOM CHORD The lower, usually horizontal, member of a truss.

BOX BEAM A hollow built-up structural unit.

BRIDGING Cross blocking between horizontal members used to add stiffness. Also called blocking.

BRITISH THERMAL UNIT (Btu) A common unit of heat defined generally as the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

BUILDING CODE Building requirements of a local governing body providing for the safety, health, and welfare of the public during construction and occupancy; contains standards for materials, structural strength, fire resistance, ventilation, and other considerations.

BUILDING LINE The line, established by law, beyond which the building shall not extend except as specifically provided by law.

BUILDING PAPER A waterproofed paper used to prevent the passage of air and water into a structure.

BUILT-UP ROOF A roof made up of several layers of felt, each spread with hot coal tar pitch or asphaltum.

BUILT-UP BEAM A beam constructed of smaller members.

BULB TEE Inverted T-shaped steel member with its vertical stem enlarged into a bulb shape; usually used for the support of poured roof-deck panels.

BULKHEAD Boxlike structure built over an opening such as a stair way or an elevator shaft; usually on a roof of a building.

BULLNOSE TRIM The face & jamb width joined by a radius rather than a 90 degree break.

BUTT JOINT The junction where two members meet in a square-cut joint; end to end, or edge to edge.

BUTT WELD Welded joint of two pieces butted together rather than overlapped.

BUTTERED WALL Sloping concrete or masonry wall with the base thicker than the top.

CABINET JAMB Frame in three or more pieces applied as the finished frame over rough buck.

CABINET WORK The interior finish woodwork of a structure, especially cabinetry.

CAISSON Watertight compartment extending below groundwater level to facilitate construction work or the removal of earth for the pouring of piers or the driving of piles.

CAMBER Slight convex (upward) curve of a beam; usually introduced to partially offset the expected beam deflection under load.

CANT STRIP A small built-up area between two intersecting roof shapes to divert water.

CANTILEVER BEAM Overhanging beam with a rigidly fixed support at only one end.

CANTILEVER Extension of member, with one end free, beyond the support.

CAP See Soffit.

CASED OPENING Frame section which does not have any stops.

CASEMENT WINDOW A window in which each sash opens outward on hinges placed at the side of the sash.

CAST STONE A building stone manufactured from concrete; usually precast and used as a trim, veneer, or facing on (or in) buildings or structures.

CASING The metal or wood molding used as a finishing trim around door and window openings.

CAST-IN-PLACE PILE Pile constructed by sinking a hollow tube into the ground and filling the tube with concrete.

CAST-IRON PIPE Widely used pipe in water distribution systems for many years; made of cast iron and manufactured in sizes from 4" to 48" in diameter; usually connected with bell and spigot joints, although flanged joints are available.

CATCH BASIN An underground structure open to the surface for the purpose of collecting water runoff and conducting it to an underground drainage system.

CATHEDRAL WINDOW A window with an upper edge which is parallel to the roof pitch.

CAULKING A soft, waterproof material used to seal seams and cracks in construction.

CAVITY WALL A wall built of masonry units so arranged as to provide an air space within the wall between wythes, and constructed so that the inner and outer parts of the wall are tied together with metal ties.

CEILING JOIST The horizontal member of the roof which is used to resist the outward spread of the rafters and to provide a surface on which to mount the finished ceiling.

CEMENT Usually refers to portland cement; a finely powdered substance, usually grey, composed largely of artificial crystalline minerals, the most important being calcium and aluminum silicates; widely used in construction.

CENTRAL HEATING A heating system in which heat is distributed throughout a structure from a single source.

CHAIRS Metals supports made of heavy wire to hold steel reinforcing bars in place during the concrete pouring operation.

CHAMFER Beveled edge rather than a sharp corner formed on a concrete member; usually accomplished by inserting chamfer strips (with triangular cross section) in concrete forms.

CHANNEL A rolled piece of structural iron with sides bent up to take the cross section shape of a channel.

CHASE A recessed area or column formed between structural members for electrical, mechanical, or plumbing materials.

CHECK VALVE A valve that allows fluid to flow in one direction only.

CHILLED WATER The refrigerated water used to cool the air in air systems.

CHIMNEY An upright structure connected to a fireplace or furnace that passes smoke and gases to outside are.

CHORD The upper and lower members of a truss which are supported by the web.

CIRCUIT An electrical arrangement requiring a source of voltage, a closed loop of wiring, an electric load, and some means for opening and closing it.

CIRCUIT BREAKER A switch-type mechanism that opens automatically when it senses an overload (excess current).

CIRCULATING LINE Piping that permits circulation of domestic hot water for more rapid availability of heated water.

CLEANOUT A removable plug in a drainage system.

CLERESTORY A window or group of windows which are placed above the normal window height, often between two roof levels.

COLLAR TIES A horizontal tie between rafters near the ridge to help resist the tendency of the rafters to separate.

COLONIAL A style of architecture and furniture adapted from the American colonial period.

COLUMN A vertical structural member that usually supports slabs, beams, or girders in buildings.

COLUMN CAPITAL Name given to the upper supporting part of a column; usually enlarged or decorated.

COMBINED SEWER A sewer that carries both storm and sanitary drainage.

COMPONENT A part of a house assembled before delivery to the building site.

COMPOSITE DESIGN Structural floor system combining the stress qualities of steel beams and the compressive stress qualities of a concrete slab; caused to act together by shear connectors (steel studs) welded to the top of the steel beam.

COMPRESSION Stress resulting from squeezing force applied to a member creating a tendency for the member to be shortened.

COMPRESSOR One of the main parts of an air conditioning system required in the cooling cycle.

COMPUTER AIDED DRAFTING (C.A.D.) Using a computer as a drafting aid.

COMPUTER INPUT Information input into a computer.

COMPUTER MAINFRAME The main computer that controls many smaller desk terminals.

COMPUTER OUTPUT Information which is displayed or printed by a computer.

COMPUTER SOFTWARE Programs used to control a computer.

CONCENTRATED LOAD A load applied to a small enough portion of the beam length so that it is assumed to be applied at a point in calculations.

CONCRETE A building material made from cement, sand, gravel, and water.

CONCRETE A mixture of sand, cement and gravel in varying amounts according to use, mixed with water.

CONCRETE BLOCKS Blocks of concrete that are precast. The standard size is 8 X 8 X 16.

CONDENSATION The formation of water on a surface when warm air comes in contact with a cold surface.

CONDUCTION The transfer of heat by contact.

CONDUCTOR, DRAINAGE A vertical drain pipe for carrying rainwater.

CONDUCTOR, ELECTRICAL A wire used to carry electric current.

CONDUIT, DRAINAGE A pipe used to carry a fluid (water).

CONDUIT, ELECTRICAL An electrical raceway of metal or plastic with a round cross section.

CONSTRUCTION MANAGER A professional who offers management services to an owner and works as a team member with the architect/engineer and the contractor; usually on complex projects.

CONTINUOUS BEAM A beam supported at three or more points in such a manner that no resistance to bending of the beam exists at any support.

CONTOURS A line that represents land formations.

CONTRACT DOCUMENTS The owner-contractor agreement; contains the working drawings, specifications, conditions of the contract, all addenda, and any other items stipulated.

CONTROL DIAGRAM A diagram that shows the control scheme only. Power wiring is not shown. The control items are shown between two vertical lines. Sometimes called a ladder diagram.

CONTROL JOINT Formed or sawed joint in a masonry or concrete wall or a concrete slab; constructed to cause cracking to occur at the joint rather than elsewhere during the shrinkage of the material.

CONVECTION A transfer of heat by a moving substance such as air or water.

CONVECTOR A heating element that warms the air passing over it, which, in turn, rises to warm the surrounding space by convection.

CONVENIENCE OUTLET An electrical outlet in the wall which can be used for many purposes.

COPING A masonry (sometimes metal) cap placed on the top of a wall to protect the wall from water penetration.

CORBEL Shelf or ledge formed by projecting successive courses of masonry out from the face of the wall.

CORNER JOINT In welding, a joint between two members located at approximately right angles to each other in the form of an L.

CORNICE A horizontal molded projection which crowns or finishes the eaves of a building.

COUNTERFLASH A metal flashing used under normal flashing to provide a waterproof seam.

COURSE A continuous row of building material such as shingles.

COURSE In masonry, one of the continuous horizontal layers of masonry units, bonded with mortar; one course is equal to the thickness of the masonry unit plus the thickness of one mortar joint.

COURT An unroofed space surrounded by walls.

COVE MOLD A concave molding used on inside corners.

COVE MOLD FRAME Frame having contour faces (exposed) simulating contour of wood frame.

COVERED MALL A covered, or roofed, interior area used as a pedestrian public way; usually connecting tenant spaces and/or groups of tenant spaces housing individual or multiple tenants.

CSI Construction Specifications Institute; source of the Uniform System for Construction Specifications.

CRAWL SPACE The area between the floor joists and the ground.

CRICKET A diverter built to direct water away from an area of a roof where it would otherwise collect such as behind a chimney.

CRIPPLE A wall stud that is cut at less than full length.

CROSS BRACING Boards fastened diagonally between structural members such as floor joists to provide rigidity.

CUL-DE-SAC A dead end street with no outlet which provides a circular turn-around.

CURB LEVEL Referring to a building, the elevation at that point of the street grade that is opposite the center of the building wall nearest to and facing the street line.

CURING The chemical process which takes place in concrete after it is poured and as it attains its load bearing strength.

CURRENT, ELECTRICAL The electric flow in an electric circuit; expressed in amperes (A).

CURTAIN WALL A non load-bearing wall on the outside of a building; usually supported by a spandrel beam or girder in steel or concrete framed construction.

CUT-OUT A preparation for hardware and/or accessories.

DAMPER A moveable metal plate in a fireplace throat to regulate draft. A moveable metal plate in a duct to control the flow of air.

DATUM POINT A point of reference established by a city from with levels and distances are measured.

DEAD END A hallway, corridor, or other space so arranged that a person therein is able to travel in one direction only in order to reach an exit.

DEAD LOAD Permanent, inert load on a structure caused by the weight of all the materials out of which the structure is made and of the items permanently attached to the structure.

DECIBEL Unit for measuring the intensity of sound; 1 decibel (dB) is equivalent to the least change in sound intensity detectable by the human ear; the scale extends from 0 dB (hearing threshold) to 120 dB (threshold of feeling).

DECKING A wood material used to form the floor or roof, typically used in 1 and 2 inch thicknesses.

DEFLECTION Amount of sag of a horizontal structural member when subjected to load; usually measured at the middle of the span of the member.

DEFORMED BAR Steel reinforcing rod with a pattern of surface projections intended to increase the bond with concrete; usually used in reinforced-concrete construction.

DEGREE DAYS (DD) A measure based on climatic conditions of the severity of a heating period, usually an entire season. From weather records for each day the difference between 65 degrees F. and the mean temperature is determined. The sum of these differences for all the days in the heating season is the Degree Days for that locality.

DEMAND In plumbing, the probable maximum rate of water flow as determined by the number of water supply fixture units.

DESIGNER A person who designs buildings, but is not licensed as is an architect.

DEWPOINT The temperature at which a cooling air-water vapor mixture becomes completely saturated (100% relative humidity) and is on the verge of some moisture condensing into water. It varies with barometric pressure.

DIAGONAL TENSION The stress resulting from the combination of bending and shear stresses in a beam; this tensile stress is equal in magnitude to the shearing stress and at the beam neutral axis is inclined 45 degrees to the horizontal.

DIFFUSER An air register transferring forced air from a duct to the room.

DIGITIZER An input tool for computer aided drafting used to draw on a flat bed plotter. The device translates images to numbers for transmission to the computer.

DISK Computer storage units that store information or programs used to run the computer.

DISTRIBUTED LOAD A load, usually uniformly distributed, applied to a large enough portion of the beam length so that it is not possible to consider it as applied at a point in calculations.

DIVERTER A metal strip used to divert water.

DOMESTIC HOT WATER Potable (safe to drink) hot water as distinguished from hot water used for heating.

DORMER A structure which projects from a sloping roof to form another roofed area. This new area is typically used to provide a surface to install a window.

DOUBLE ACTING Type of door prepared for pivot or spring type door hinge permitting the door to swing 90 degrees in either direction.

DOUBLE EGRESS Double rabbeted double frame prepared to receive two single-acting doors swinging in opposite directions.

DOUBLE HUNG A type of window in which the upper and lower halves slide past each other to provide an opening at the top and bottom of the window.

DOWELS Reinforcing steel bars extended beyond a construction joint for the purpose of attaching the new pour to the hardened concrete.

DOWNSPOUT A vertical pipe to carry rainwater from the gutter to the ground or sewer. (Same as leader.)

DRAIN A pipe for carrying waste water; usually by gravity flow.

DRIFT PIN Metal pin used in lining up matching holes and temporarily joining members during steel-frame erection.

DRIP CAP A molding placed above the top of a window or door casing to provide a means for water to run off.

DRIP In masonry, a projection shaped to throw off water and prevent its running down the face of the masonry surface below.

DROP PANEL Projection on the bottom of the thickened area of a concrete flat slab; positioned directly above that supporting column.

DRY WELL A shallow well used to disperse water from the gutter system.

DRYWALL A system of interior wall finish using sheets of gypsum board.

DUCT LINER Acoustic liner to absorb sound made by air transmission through ducts.

DUCT TURNS Curved vanes that reduce friction and turbulence when square corners are used in ducts.

DUCTS Pipes, typically made of sheet metal, used to conduct hot or cold air of the HVAC system.

DUTCH DOOR Door having two separate leaves, one hung above the other. Shelf on lower leaf, optional.

DUTCH HIP A type of roof shape that combines features of a gable and a hip roof.

DWV Abbreviation for drainage, waste, and vent.

EASEMENT An area of land that cannot be built upon because it provides access to a structure or to utilities such as power or sewer lines.

EAVE The lower part of the roof that projects from the wall. See cornice.

ECCENTRIC LOAD Load applied away from the centroid of the cross section of a structural member; usually refers to an unbalanced load on a column causing a tendency for the column to bend.

EFFLUENT A fluid flowing away from a process, such as the effluent of a sewage treatment system.

EGRESS A term used in building codes to describe access.

ELBOW An L-shaped plumbing pipe.

ELEVATION The height of a floor level or grade above a given point such as sea level. The term is also used to describe the view of a building when drawn using orthographic drawing methods.

EMERGENCY SOURCE Standby source of electric power; used when normal electric power fails.

EMITTANCE (e) A rating of the ability of a material to give off heat as radiant energy. It is equal to the amount of heat absorbed (that not reflected), so the sum of emittance and reflectance, expressed as percent, is 100%. It is also defined as the ratio of heat radiated by a material to that of a "black body" under similar conditions. It is applicable only when the surface faces an air space. See Reflectance. The same ratio applied to opaque and optically flat surfaces is called emissivity; for ordinary materials, emittance is preferred.

ERECTION MARK Identification mark or number placed on the end of each steel section to aid in the erection of a steel-framed structure.

EXCAVATION The removal of soil for construction purposes.

EXPANSION JOINT A joint in masonry or concrete construction providing a plane of separation for free movement of the adjacent parts; usually containing a vinyl-type water stop and/or premolded expansion joint filler.

FACADE The exterior covering of a structure.

FACE BRICK Brick that is used on the visible surface to cover other masonry products.

FACE Exposed part of frame parallel to face of wall.

FACE GRAIN The pattern in the visible veneer of plywood.

FALL PER FOOT The slope of a drainage line that causes flow by gravity.

FASCIA A flat vertical board located at the outer face of a cornice.

FAST TRACK A method of construction management with the intention of constructing a project in the least possible time; construction work usually starts before final plans and specifications are complete.

FAYING SURFACE In welding, that surface of a member that is in contact with another member to which it is to be joined.

FEED LINE A pipe that supplies water to items such as a boiler or a domestic hot-water tank.

FIBER BENDING STRESS The measurement of structural members used to determine their stiffness.

FIBERBOARD Fibrous wood products that have been pressed into a sheet. Typically used for the interior construction of cabinets and for a covering for the subfloor.

FIELD BOLTS Bolts that are to be fastened at the job site in steel-framed construction.

FILL Material used to raise an area for construction. Typically gravel or sand is used to provide a raised, level building area.

FILLER PLATE A blank plate used to fill mortised cutouts.

FILLET WELD A weld of approximately triangular cross section joining two surfaces at approximately right angles to each other in a lap joint, tee joint, or corner joint.

FINISHED LUMBER Wood that has been milled with a smooth finish suitable for use as trim and other finish work.

FINISHED SIZE Sometimes called the dressed size, the finished size represents the actual size of lumber after all milling operations and is typically about ½ inch smaller than the normal size, which is the size of lumber before planing.

NOMINAL SIZE (IN.)	FINISHED SIZE (IN.)
1	3/4
2	1 1/2
4	3 1/2
6	5 1/2
8	7 1/4
10	9 1/4
12	11 1/4
14	13 1/4

FIRE CUT An angular cut on the end of a joist or rafter that is supported by masonry. THe cut allows the wood member to fall away from the wall without damaging a masonry wall when the wood is damaged by fire.

FIRE DOOR A door and its assembly, so constructed and assembled in place as to give the specified protection against the passage of fire.

FIRE RATED A rating given to building materials to specify the amount of time the material can resist damage caused by fire.

FIRE-RESISTANCE RATING The time, in hours, that the material or construction will withstand the standard fire exposure as determined by a fire test (in conformity with ASTM E119). Sometimes called fire rating.

FIRE WALL A fire-resistive wall, having protective openings, that restricts the spread of fire and extends from foundation to, or through, the roof; to allow collapse on either side without the wall itself collapsing under fire conditions.

FIREBOX The combustion chamber of the fireplace where the fire occurs.

FIREBRICK A brick made of a refractory material that can withstand great amounts of heat and is used to line the visible face of the firebox.

FIREPROOFING Any material that is used to cover structural materials to increase their fire rating.

FIRESTOP Any blocking of air passages to prevent the spread of fire in a building. (A block of wood closing off a space between studs.)

FIXTURE A unit of electrical or plumbing equipment; usually indicated in fixture schedules or drawings.

FLAGSTONE Flat stones used typically for floor and wall coverings.

FLAME-SPREAD RATING A numerical value assigned to a material tested in accordance with "Methods of Test for Surface Burning Characteristics of Building Materials," ASTM E84.

FLANGE Bottom and top portion of an S-section (I-beam), W-section (wide flange), or C-section (channel) steel beam.

FLARE An operation performed on the end of copper tubing before it is joined to another piece.

FLASHING Sheet-metal placed in mortar joints and across air spaces in masonry to collect water that may penetrate the wall and to direct the water to the exterior.

FLAT FRAME Frame having flat faces exposed.

FLAT PLATE Type of reinforced-concrete floor or roof system where the slab has a uniform thickness and is supported only by columns.

FLAT SLAB Type of reinforced-concrete floor or roof system of uniform thickness except at the column supports, where the slab is thickened by drop panels that extend down below the bottom surface of the slab.

FLOOR Distance between bottom of door and finished floor.

FLUE A passage inside of the chimney to conduct smoke and gases away from a firebox to outside air.

FLUE LINER A terra-cotta pipe used to provide a smooth flue surface so that unburned material will not cling to the flue.

FLUSH VALVE A valve that, when operated manually, delivers a measured amount of water to flush a water closet.

FOOTING The spread portion at the base of a foundation wall or column which distributes the weight over a larger area.

FOUNDATION The system used to support a building's loads and made up of stem walls, footings, and piers. THE term is used in many areas to refer to the footing.

FRAME CONSTRUCTION Building using wood structural members.

FRAME The structural skeleton of a building.

FRIEZE The part of a cornice which is the lower vertical board at the wall.

FROST LINE The depth to which frost penetrates the earth.

FURRING STRIPS Narrow strips of wood fastened to a wall or ceiling to serve as a leveling device and to provide a means for fastening the finishing materials.

FURRING Wood strips attached to structural members that are used to provide a level surface for finishing materials when different-sized structural members are used.

GABLE END WALL The triangular wall that is formed at each end of a gable roof between the top plate of the wall and the rafters.

GABLE ROOF A ridged roof that slopes up from two sides.

GAGE LINES In steel framing, lines on which bolts or open holes for bolts are placed; usually 3" apart.

GALVANIC CORROSION Corrosion caused by the contact of different metals, which are improperly isolated, in the presence of a liquid that can conduct electricity.

GALVANIZING Zinc coating of metal by electroplating or hot dipping, which produces a characteristic bright spangled finish and protects the base metal from atmospheric corrosion.

GAMBREL A type of roof formed with two planes on each side. The lower pitch is steeper than the upper portion of the roof.

GAUGE Measure of thickness or size of metal or wire, as in 26-gauge metal flashing.

GIRDER As used in buildings, a horizontal structural member that supports at least one beam; supported by other girders or columns.

GLASS STOP Fixed trim on a glass tight door against which glass is set.

GLAZING BEAD A removable trim at glazing opening to hold glass securely in place.

GRADE BEAM Continuous reinforced-concrete beam below grade that forms the foundation of a building. Piers or piles are usually used below the beam for support.

GRADE Referring to buildings, a reference plane representing the finished ground level adjoining the building at exterior walls.

GRADING The moving of soil to effect the elevation of land at a construction site.

GRAVEL STOP A metal strip used to retain gravel at the edge of built-up roofs.

GRAVITY LOADS Those loads on a structure that are caused by the attraction of gravity as opposed to wind loads, earthquake loads, etc. Gravity loads act downward in a vertical direction.

GRILLS Perforated or slotted frame; usually used for air return in an air system.

GROUT A mixture of cement, sand, and water used to fill joints in masonry and tile construction.

GUARDRAIL A horizontal protective railing used around stairwells, balconies, and changes of floor elevation greater than 30 inches.

GUSSET A plat added to the side of intersecting structural members to help form a secure connection and to reduce stress.

GUTTER A metal or plastic drainage system for collecting and disposing of water from roofs.

GYPSUM A calcium product used in plaster and as a core in sheets of drywall.

GYPSUM BOARD An interior finishing material made of gypsum and fiberglass and covered with paper which is installed in large sheets.

HALF-TIMBER A frame construction method where spaces between wood members are filled with masonry.

HAND Term used to designate direction in which door swings.

HANDHOLD Small exterior concrete box intended as a pulling or splicing point for underground cables.

HANDING The swinging of the door e.g., right hand or left hand. To determine the hand of a door, view the door from the outside. The side that the hinges are on is the hand of the door. If the door swings away from the viewer, the hand is a regular hand, i.e. right or left hand. If the door swings to the viewer, the door is reverse swing, i.e. right hand reverse swing or left hand reverse swing.

HANGER A metal support bracket used to attach two structural members.

HARDBOARD Sheet material formed of compressed wood fibers used as an underlayment for flooring.

HEAD Horizontal frame member at top of door opening or top member of transom frames.

HEADER A joist or joists placed at the ends of an opening in the floor used to support side members. The top rough framing members over a window or door opening.

HEADER COURSE Course of brick or masonry laid across a wythe of masonry (with the ends exposed); usually used to bond one wythe of masonry to another in a wall.

HEADROOM The vertical clearance in a room or over a stairway.

HEARTH The fire-resistant floor within and extending a minimum of 18 inches in front of the firebox.

HICKEY A tool used to bend conduit.

HIGH-STRENGTH BOLTS Fastening bolts of superior-strength steel having hexagon heads and used with semifinished hexagon nuts; intended to be tightened to a high tensile stress to provide a clamping force on the material joined that allows load transfer by friction.

HINGE BACKSET Distance from edge to hinge to stop on frame.

INGE FILLER Plate installed for a hinge cut-out when no hinge Plate is uired.

ROOF A roof sloping up from all sides or walls of a building.

P The exterior edge formed by two sloping roof surfaces.

IOSE BIBB A water faucet or valve connection for a garden hose.

HUMIDITY, ABSOLUTE The weight of water vapor in pounds per cubic foot.

HUMIDITY, PERCENTAGE Indicates the weight of moisture that air at a given temperature is holding in vapor form to what it could hold at that same temperature when fully saturated, as percent.

HUMIDITY, RELATIVE (RH) The ratio of the actual vapor pressure at a given temperature to the saturation vapor pressure at the same temperature.

HVAC Abbreviation for heating, ventilating, and air conditioning.

HYDRATION The chemical reaction of water and cement that produces a hardened concrete.

HYDRONIC SYSTEM Forced hot water system.

I BEAM The generic term for a wide flange or American standard steel beam with a cross section in the shape of the letter I.

INACTIVE LEAF The door leaf in a pair of doors which is normally held closed by top and bottom bolts.

INFLECTION POINT A point along the length of a beam where the curvature, due to deflection, changes from concave to convex, or vice versa; the type of stress (tension or compression) on the bottom (or top) also changes at this point.

INNER COURT An open unoccupied space bounded by the walls of a building, but located within the exterior walls of the building.

INVERT The elevation, above some datum, of the lowest surface in a pipe, manhole, or catch basin.

ISOMETRIC A drawing method which enables three surfaces of an object to be seen in one view, with the base of each surface drawn at 30° to the horizontal plane.

ISOTHERM Designates a line on a graph joining points of equal temperatures.

JACK RAFTER A rafter which is cut shorter than the other rafters to allow for an opening in the roof.

JACK STUD A wall member which is cut shorter than other studs to allow for an opening such as a window. Also called a cripple stud.

JALOUSIE A type of window made of thin horizontal panels that can be rotated between the open and close position.

JAMB DEPTH Over-all width of frame section.

JAMB Vertical frame member; between door and glass or wall; between glass and door or wall. See also Mullion.

JIG A table or device used to hold structural members in place while they are being fastened together. Used in the manufacture of components and trusses.

JOIST A horizontal structural member used in repetitive patterns to support floor and ceiling loads.

KICK PLATE Metal plate fastened to the lower part of a door to prevent damage to the door.

KILN DRIED A method of drying lumber in a kiln or oven. Kiln dried lumber has a reduced moisture content when compared to lumber that has been air dried.

KING STUD A stud placed beside the cripples at the edge of an opening in a wall which extends from the top plate to the sill.

KIP Used in some engineering formulas to represent 1,000 pounds.

KNOCK DOWN Door frame furnished by manufacturer in three or more basic parts for assembly in field.

LAITENCE Undesirable watery liquid that sometimes forms on the surface of concrete slabs while curing.

LALLY COLUMN A metal pipe filled with concrete used to support beams or girders.

LAMINATED Several layers of material that have been glued together under pressure.

LANDING A platform between two flights of stairs.

LAP JOINT A joint between two overlapping members.

LATERAL Sideways action in a structure caused by wind or seismic forces.

LATERAL SUPPORT Support provided to structural members, subjected to bending, that prevents the member from moving laterally or twisting during the application of load.

LATH Metal mesh or wood strips which are fastened to structural members to provide a base for plaster.

LATTICE A grille made by criss-crossing strips of material.

LAUNDRY TRAY A laundry sink.

LAVATORY (1) A basin for washing the hands and face; (2) A room equipped with running water usually containing a basin and water closet.

LEADER A pipe that carries storm water down from a gutter or roof drain fixture.

LEDGER A horizontal member which is attached to the side of wall members to provide support for rafters or joists.

LEVEL (1) Horizontal; (2) A builder's instrument used to transfer points in laying out foundations, revolves only in a horizontal plane; (3) A carpenter's or mason's tool used to level building parts in the course of building; (4) To adjust into a horizontal position.

LIFE SAFETY CODE Regulations governing fire protection requirements of buildings; usually administered by the fire marshal.

LIFT SLAB Method of precast concrete construction. Roof and all floor slabs are cast and cured on the ground and lifted into place after hardening.

LIGHT A pane of glass.

LINTEL The beam like structural support, placed over an opening in a wall, that supports the wall construction above.

LIVE LOAD The loads from all movable objects within a structure including loads from furniture and people. External loads from snow and wind are also considered live loads.

LOAD-BEARING WALL A support wall which holds floor or roof loads in addition to its own weight.

LOAD FACTOR Number that results by dividing the failure load by the working load; sometimes substituted for the safety factor in codes and specifications.

LOCK BACKSET Distance from edge of door to centerline of cylinder of cylinder knob.

LOOKOUT A beam used to support eave loads.

LOUVER An opening with horizontal slats to allow for ventilation.

LOUVER DOOR A door with horizontal ventilating slats.

LUG SILL Stone or concrete sill below windows on exterior walls that is wider than the window opening and is set into the adjoining masonry.

MANHOLE Large exterior concrete box or vault intended as a pulling or splicing point for underground primary cables, large secondary cables, and telephone cables, also used to allow access to sewers.

MANSARD A four-sided, steep-sloped roof.

MANTEL A decorative shelf above the opening of a fireplace.

MASONRY BOX See Plaster Guard.

MASONRY That form of construction composed of stone, brick, concrete, gypsum, hollow clay tile, concrete block, tile, or other similar building units or materials laid up unit by unit and set in mortar.

MESH A metal reinforcing material placed in concrete slabs and masonry walls to help resist cracking.

MEZZANINE One or more intermediate levels between the floor and ceiling of any story, with a total area of all mezzanines comprising one-third or less of the space in which they are located.

MILLWORK Finished woodwork that has been manufactured in a milling plant. Examples are window and door frames, mantels, moldings, and stairway components.

MODULAR A structural system designed to have the parts fit together on a grid of a standard module.

MODULE (1) A unit of measurement established at 4 inches; (2) A complete part of a building assembled in a shop such as a bathroom or kitchen.

MODULUS OF ELASTICITY The measurement of the tendency of a structural member to sag.

MOISTURE BARRIER Typically a plastic material used to restrict moisture vapor from penetrating into a structure.

MOLDING Decorative strips, usually made of wood, used to conceal the seam in other finishing materials.

MOMENT DIAGRAM Graphic description of the intensity of the bending moments along the length of a structural member.

MOMENT See bending moment.

MORTAR A combination of cement, sand, and water used to bond masonry units together.

MORTISE Reinforcing drilling and tapping for hardware preparation which is to be mortised into door or frame.

MUDSILL The horizontal wood member that rests on concrete to support other wood members.

MULLION The structural member between windows which come in pairs or in a series.

MUNTIN The small members dividing the glass lights in a window sash.

NAILER A wood member bolted to concrete or steel members to provide a nailing surface for attaching other wood members.

NEMA National Electrical Manufacturers Association; an association that establishes standards of manufacture for electrical equipment.

NEUTRAL AXIS The center of gravity axis (or centroidal axis of the cross section) of a structural member where the bending stresses (tension and compression) are zero.

NEWEL The end post of a stair railing.

NFPA National Fire Protection Association; the source for many standards for fire protection.

NOMINAL SIZE An approximate size achieved by rounding the actual material size to the nearest larger whole number.

NONBEARING WALL A wall which supports no loads other than its own weight. Some building codes consider walls which support only ceiling loads as nonbearing.

NONCOMBUSTIBLE MATERIAL Materials that pass the test procedure defining noncombustibility (ASTM E136) or those having a structural base with a surfacing 1/8" or less having a flame-spread rating of 50 or less as tested according to ASTM E84.

NOSING The rounded front edge of a tread which extends past the riser.

OCCUPANCY The purpose for which a building, or part thereof, is used or intended to be used; such as Educational Occupancy.

ON CENTER A measurement taken from the center of one member to the center of another member.

OPEN WEB JOIST Light steel truss like member used for floor or roof framing; sometimes allied bar joist.

OPENING SIZE Size of frame opening measured between rabbets and finished floor.

OUTLET An electrical receptacle which allows for current to be drawn from the system.

OUTRIGGER A support for roof sheathing and the fascia which extends past the wall line perpendicular to the rafters.

OVERALL HEAT TRANSMISSION COEFFICIENT (U or 1/RT) The reciprocal (divided into 1) of the Total Thermal Resistance. "U" has been the unit used to express heat flow through a building section including air spaces 3/4 inch or greater and air films. Technically, it is heat transmission in Btu's per hour per square foot per degree F difference from air to air. While it has been used to calculate heat loss or gain, it is recommended that it be abandoned in favor of the more easily used Total Thermal Resistance (RT).

OVERHANG THe horizontal measurement of the distance the roof projects from a wall.

OVERHANGING BEAM A horizontal member resting freely on two supports, with one or both of the beam ends extending out beyond the supports.

OVERLAY DRAFTING The practice of drawing a structure in several layers which must be combined to produce the finished drawing.

OWNER Any person, agent, firm, or corporation having a legal or equitable interest in the property or building.

PAD An isolated concrete pier.

PAN-JOIST or ONE-WAY-JOIST FLOOR Type of concrete floor or roof construction having joists (sometimes called ribs) formed on the bottom of the slab.

PANEL or PANELBOARD A box containing a group of over current devices intended to supply branch circuits.

PANIC HARDWARE Door latches, required by building codes, to be provided on exit doors of certain types of buildings, they release when pressure, not exceeding 15 lbs, is applied to the releasing devices in the direction of exit travel.

PANS Steel or plastic forms, in the shape of pans, used in forming one-way joist (ribbed) and two-way joist (waffle) type concrete floor and roof framing systems.

PARAPET WALL That part of any wall entirely above the roof line of a building.

PARTING STRIP A vertical strip attached to the jamb of a double hung window used to separate the upper and lower sash as they slide up and down.

PARTITION An interior wall, other than one that is folding or portable, that subdivides spaces within a building.

PARTY WALL A fire wall on an interior lot line, used or adapted for joint service between two buildings.

PASS-THROUGH An opening in a kitchen wall used to pass dishes to and from the dining room (Also *pass-thru*.)

PEDESTAL Column base support that is placed between a column and a footing.

PENTHOUSE An enclosed structure above the roof of a building, other than a bulkhead, occupying not more than one-third of the roof area.

PERM Unit of vapor transmission rate of 1 grain per square foot per hour per inch of mercury pressure difference (from permeance).

PERMIT An official document or certificate issued by an authority having jurisdiction for authorizing performance of a specified activity, such as a building permit, which authorizes the construction of a building.

PERSPECTIVE A drawing method which provides the illusion of depth by the use of vanishing points.

PHOTODRAFTING The use of photography to produce a base drawing on which additional drawings can be added.

PIER A concrete or masonry foundation support.

PILASTER A thickened wall section of column built as an integral part of a wall.

PILE Long shaft of wood, concrete, prestressed concrete, or steel; cast or driven into the ground to give support to a foundation; usually used to support heavy loads or when stable soil is far below unstable surface soil.

PILING A vertical foundation support driven into the ground to provide support on stable soil or rock.

PITCH (1) The slope of a floor toward a drain expressed in inches per foot; (2) A ratio between the rise of a roof and the span.

PLANCIER A board which is the underside of an eave or cornice.

PLANK Lumber which is 1½ to 3½ inches in thickness.

PLASTER A pasty composition of lime, sand and water which hardens on drying, used for coating wall and ceiling surfaces.

PLASTER GUARD Metal shield attached behind hinges and strike reinforcement to prevent mortar or plaster from entering mounting holes.

PLASTIC DESIGN Method of structural steel design, used by engineers, utilizing the ultimate strength of a structure (failure loading). It is based on the ductility of steel (a plastic behavior).

PLAT A map of an area of land which shows the boundaries of individual lots.

PLATE A horizontal member at the top (top plate) or bottom (sole plate or sill) of walls used to connect the vertical wall members.

PLATE GIRDER Steel beam or girder built up with a plate web and plate or angle sections as flanges.

PLENUM An air compartment or chamber to which one or more ducts are connected and that forms part of an air-distribution system.

PLOTTER An output device used in computer aided drafting to draw lines and symbols.

PLUMB (1) Vertical; (2) To adjust into a vertical position.

PLYWOOD Wood composed of three or more layers, with the grain of each layer placed at 90° to each other and bonded with glue.

POCHE A shading method using graphite applied with a soft tissue in a rubbing motion.

POST A vertical wood structural member usually 4 X 4 or larger.

POSTTENSIONING Type of prestressed concrete where the tendons are tensioned and anchored at the ends of the member after the concrete has been cast and has attained sufficient strength.

POTABLE Safe to drink.

PRECAST CONCRETE Concrete units cast and finished before being erected in place.

PRESTRESSED CONCRETE Concrete members that have been placed in a stress state of compression prior to being loaded; the stress is usually induced by the tensioning of steel tendons.

PRETENSIONING Type of prestressed concrete where the tendons are tensioned prior to the casting of the concrete and the member is stressed after the concrete has gained sufficient strength.

PRIMARY AIR Heated or cooled air directly from the conditioner.

PRIMARY SERVICE High-voltage service (above 600 volts).

PROCTOR TEST A soil-compaction laboratory test run to determine the water content-density relationship of a soil; a controlled amount of energy is used to compact a sample of soil, after which the water content and the density are determined; the test is repeated until a maximum density of soil is obtained; used to compare with actual field compaction to determine compliance with specifications; for example, "compact subgrade to 90% of Standard Proctor." The Modified Proctor test utilizes a larger amount of energy for compaction.

PROGRAM A set of instructions which controls the functions of a computer.

PSI Pounds per square inch.

PULL BOX A metal cabinet inserted into a conduit run for the purpose of providing a cable-pulling point; cable may be spliced in these boxes.

PURLIN BRACE A support member which extends from the purlin down to a load-bearing wall or header.

PURLIN Horizontal roof-framing member used over widely spaced trusses.

PVC Abbreviation for polyvinyl chloride; most widely used as plastic pipe for water services and for waste-collection systems; tough and resistant to chemical attack; used for intermediate strength and high flexibility.

QUARRY TILE Machine made, unglazed floor tile.

QUARTER ROUND Wood molding that has the profile of one-quarter of a circle.

R-FACTOR A unit of thermal resistance applied to the insulating value of a specific building material.

RABBET A rectangular groove cut on the edge of a board.

RACEWAY Channel in a building through which wiring or piping is run.

RADIANT HEAT A system in which space is heated by the use of pipe coils or electric resistance wires placed in the floor, ceiling or walls.

RADIATION The transfer of heat through space by the wave motion of rays.

RAFTER A sloping roof member which supports the roof covering.

RAFTER/CEILING JOIST An inclined structural member which supports both the ceiling and the roof materials.

RAIL A horizontal member of a door or a window sash.

RAKE JOINT A recessed mortar joint.

RANDOM A manner of laying stones so that they do not follow regular patterns or courses.

REACTION The upward forces acting at the supports of a beam.

READY-MIXED CONCRETE Concrete mixed at a plant or in trucks enroute to the job site and delivered ready for placement.

REBAR Reinforcing steel used to strengthen concrete.

RECEPTACLE A receptacle is a contact device installed at the outlet for the connection of a single attachment plug.

RECEPTACLE OUTLET An outlet where one or more receptacles are installed.

REFERENCE BUBBLE A symbol used to designate the origin of details and sections.

REFLECTANCE A rating of the ability of a material to reflect heat by radiation. It is the ratio of the radiant heat reflected by a surface to that of a "black body" (a theoretical body that absorbs all radiation falling on it) under similar conditions. No symbol is used because ratings are based on emittance. For opaque and optically flat surfaces the optimum value of reflectance is reflectivity for ordinary materials, reflectance is preferred.

REGISTER Slotted frame for control of the direction and flow rate of air delivered to the surrounding space in air systems.

REINFORCED CONCRETE Concrete that has had steel reinforcing bars added to increase the strength of the concrete in tension.

REINFORCING STEEL Steel rods of various sizes used to limit the width of tension cracks and carry tension loads in reinforced concrete.

RELATIVE HUMIDITY The amount of water vapor in the atmosphere compared to the maximum possible amount at the same temperature.

RELIEF ANGLE Steel angle attached horizontally to the structural frame of a building for the support of masonry veneer that is beyond the main framework.

RENDERING An artistic process applied to drawings to add realism.

REP A reciprocal (1/perm) which indicates resistance to water vapor transfer.

RETAINING WALL A wall designed to prevent the lateral displacement of soil or other material.

RETARDER An admixture added to concrete to delay the hardening process.

RETURN See Backband.

REVEAL Distances from face of frame to surface of finished wall.

REVERBERATION The continuing travel of sound waves between reflective surfaces after the original source is stopped.

REVERBERATION TIME The time, in seconds, required for a sound to diminish 60 decibels after the source is stopped.

REVERSE BEVEL Refers to hand of door or lock when doors swing to outside.

REVERSING See End Channel.

RIBBED SLAB See pan-joist floor.

RIBBON A structural wood member framed into studs to support joists or rafters.

RIDGE BOARD A horizontal member that rafters are aligned against to resist their downward force.

RIDGE BRACE A support member used to transfer the weight from the ridge board to a bearing wall or beam. The brace is typically spaced at 48 inches O.C., and may not exceed a 45° angle from vertical.

RIDGE The uppermost area of two intersecting roof planes.

RIGID FRAME Structural system utilizing rigid structural connections between the beam and column sections; the beam and column sections are frequently tapered and the beam sections are many times placed on a slope.

RIM JOIST A joist at the perimeter of a structure that runs parallel to the other floor joist.

RISE On a roof built using *simple rafters*, the "rise" is the vertical (straight up and down and plumb) distance measured from the highest point (the ridge) of the rafter, to the lowest point at the other end of the rafter.

RISER A vertical board at the edge of a stairway step.

RISER DIAGRAM Plumbing or electrical block type of diagram showing connections of major items of equipment; also applied to signal equipment connections such as fire-alarm riser diagram. Usually applied to multistory buildings.

ROLL ROOFING Roofing material of fiber or asphalt that is shipped in rolls.

ROLLED SECTION Structural steel member, such as an S-section (I-beam) or W-section (wide flange), that is formed into shape by hot rolling at a steel mill.

ROOF DRAIN A metal water collector flashed into a flat roof; usually provided with a strainer to exclude debris.

ROOF SLOPE Pitch of a flat roof intended to direct rain water to a roof drain.

ROUGH FLOOR The subfloor, usually hardboard, which serves as a base for the finished floor.

ROUGH-IN DIMENSIONS In plumbing, the locations of water supply and drainage pipes to assure proper fit of a plumbing fixture.

ROUGH OPENING The unfinished opening between framing members allowed for doors, windows, or other assemblies.

ROWLOCK A pattern for laying masonry units so that the end of the unit is exposed.

RUBBER A part attached to the stop of a frame to cushion the closing of door.

RUBBLE A wall made of rough stones irregular in size and shape, laid without a pattern.

RUN (*Plumbing*) A part of a pipe or fitting that continues in the same straight line as the direction of flow. (*Roof*) On a roof built using *simple rafters*, the "run" is the horizontal (straight across and level) distance measured from the highest point (the ridge) of the rafter, to the farthest point at the other end of the rafter.

RUN The horizontal distance of a set of steps or the measurement describing the depth of one step.

S-SECTION Designation for a standard beam (formerly called I-beam).

SADDLE A small gable roof placed behind a chimney on a sloped roof to shed water.

SAFETY FACTOR Number that results from dividing ultimate strength (concrete) or the yield strength (steel) by the allowable or working stress; usually regulated by building codes.

SASH The frame in which the window lights (glass) are set.

SCAB A short member that overlaps the butt joint of two other members used to fasten those members.

SCALE A measuring instrument used to draw materials at reduced size.

SCHEDULE A written list of similar components such as windows or doors.

SCRATCH COAT THe first coat of stucco which is scratched to provide a good bonding surface for the second coat.

SCREEDS Strips fastened at a desired level, over which a straightedge is pulled to level a concrete slab; the name is also applied to the straightedges themselves.

SCUPPER Opening in a wall for the release of water from a roof or floor; intended to regulate the maximum depth to which water may stand on a roof or floor.

SCUTTLE A small opening in the ceiling to provide access to the attic space.

SEATED CONNECTION Connection in steel-framed construction formed by the outstanding leg of an angle or plate on which to rest a beam or girder.

SECTION A view taken of a building or a part of a building as seen in a vertical slice.

SECTION WIDTH See Jamb Depth.

SEISMIC Relating to vibration and forces caused by an earthquake.

SELF-CLOSING Referring to a fire door or other opening; a door, normally closed, equipped with an approved device that will ensure that the door is closed after having been opened for use.

SELF-WEATHERING A type of steel that has chemical properties allowing it to form a very dense surface oxide (rust), which seals the base metal from further oxidation (rusting).

SEPTIC TANK A tank in which sewage is kept in order that bacterial action may cause disintegration of organic matter and dispersed by drainlines.

SERVICE DROP The overhead electrical service wires that serve a building.

SETBACK A specific minimum distance that a structure must be placed from a lot line.

SHAFT In reference to a building, a vertical opening extending through one or more stories, for elevators, dumbwaiters, light, ventilation, or similar purposes.

SHALL As used in a building code, it means mandatory.

SHAKE A hand-split wooden roof shingle.

SHEAR Condition in a loaded member resulting from forces or load placement that causes a sliding tendency within the cross section of the member.

SHEAR DIAGRAM Graphic description of the intensity of shear forces along the length of a loaded structural member.

SHEAR PANEL A plywood panel applied to walls to resist wind and seismic forces by keeping the studs in a vertical position.

SHEAR PLANE The plane passing through the cross section of a member subjected to shear; usually used to define the cross section of a bolt at the contact surface between two plates being connected by the bolt.

SHIM A piece of material used to fill a space between two surfaces.

SHIPLAP Lumber which has been wored or rabbeted along each edge to provide a close lapped joint by fitting two pieces together.

SHOP BOLTS Structural bolts that are fastened on steel members in the fabrication shop before delivery of the members to the job site.

SHOP DRAWINGS Contractor's, fabricator's, or manufacturer's drawings giving equipment, construction, or placement details; usually must be reviewed by architect, engineer, and the general contractor.

SHORING Wood or steel posts (or shores) used to support slabs, beams, walls, or other parts of a building during construction.

SIDING Outside wall finish in long narrow units.

SILL (1) The bottom rough structural member which rests on the foundation; (2) The bottom exterior member of a window or door.

SILL COCK An outside valve for the connection of a hose.

SIMPLE BEAM A horizontal beam supported at each end in such a manner that the supports allow the beam to bend freely or to change in length without restraint due to applied loads.

SINGLE ACTING Type of door prepared for a pivot type or spring-door type single-acting hinge permitting the door to swing 90 degrees in one direction only.

SITE The location of the building.

SJI Steel Joist Institute; source for specifications and standards for open-web steel joists.

SKYLIGHT An opening in the roof to allow light and ventilation that is usually covered with glass or plastic.

SLAB A concrete floor system typically poured at ground level.

SLAB-ON-GRADE A concrete slab that is supported throughout its entire area by some form of subgrade; sometimes called slab-on-ground.

SLEEPERS Strips of wood placed over a concrete slab in order to attach other wood members.

SLIP SILL Beveled cast-concrete or stone sill piece placed below a window to shed water; sill has the same width as the window opening.

SMOKE CHAMBER THe portion of the chimney located directly over the firebox which acts as a funnel between the firebox and the chimney.

SMOKE DETECTOR An approved detector sensing either visible or invisible particles of combustion; usually producing an audible alarm.

SMOKE SCREEN A door frame combined with sidelights on either or both sides of door openings, including transom opening when and if required.

SMOKE SHELF A shelf located at the bottom of the smoke chamber to prevent downdrafts from the chimney from entering the firebox.

SOFFIT A lower horizontal surface such as the underface of eaves, cornice or beam.

SOIL BORING Boring of the subsurface soil to obtain soil samples for the purpose of investigating the load-bearing and stability characteristics of the soil under the site or proposed construction.

SOIL-CEMENT Mixture of soil and cement for the purpose of obtaining an economical, stable material; usually used as a paving underlayment.

SOIL STACK A vertical pipe which runs from the soil pipe to the house drain to carry waste including that from water closets.

SOLDIER Masonry unit set vertically on end with face showing on the exterior.

SOLE The horizontal member of a frame wall or partition which rests on the floor.

SOLENOID An electrical device which closes when current passes through a magnetic coil.

SPAN The horizontal distance between two supporting members.

SPANDREL BEAM A horizontal beam along the outside of a structure that is supported by columns on each end.

SPECIFICATIONS A written set of instructions prepared by the architect covering materials, procedures, quality of workmanship and guarantees.

SPLICE Two similar members that are jointed together in a straight line usually by nailing or bolting.

SPLIT JAMBS Frames with jamb width in two pieces.

SPLIT-LEVEL A house that has two levels, one about a half a level above or below the other.

SPLIT RING A metal device used at joints in wood trusses used to keep the members in position.

SPREAD FOOTING Concrete footing that is larger than the structural member it supports for the purpose of spreading the load to the soil below.

SPRINKLERED Means that the building is equipped with an approved automatic sprinkler system that will automatically spray water to extinguish a fire when activated; usually also activates a building alarm.

SQUARE An area of roofing covering 100 quare feet.

STACK A vertical plumbing pipe.

STAIR WELL The opening in the floor where a stair will be framed.

STAIRWAY One or more flights of stairs, and the necessary landings and platforms connecting them to form a continuous and uninterrupted passage from one story to another in a building.

STANDARD FIRE TEST The first test formulated under the procedure specified in "Methods of Fire Tests of Building Construction and Materials," ASTM E119.

STANDPIPE An arrangement of piping, valves, hose outlets, and allied equipment installed in a building and located so that water can be discharged through hose and nozzles for the purpose of extinguishing a fire.

STEEL JOIST See open web joist.

STIFFENER Metal angle or plate fastened to steel members where local buckling of the material might occur; vertical and horizontal stiffeners are used.

STILE A vertical member of a cabinet, door, or decorative panel.

STILTS See Floor Struts.

STIRRUPS Steel reinforcing placed near the ends of concrete joists, beams, or girders to resist diagonal tension stresses; usually U-shaped, they are placed perpendicular to the longitudinal axis of the beam.

STOOL The shelf-like piece which crosses the bottom of a window on the inside.

STOP The inside molding or piece of trim fastened to the jamb which holds the bottom sash in place on a double hung window.

STORM DRAINAGE Removal of rainwater from a roof, parking lot, or other area at a building site.

STORY That portion of a building included between the upper surface of a floor and the upper surface of the next floor (or roof) above.

STREET Any public thoroughfare or space more than 20 feet in width that has been dedicated for public use.

STRESSED-SKIN PANEL A hollow,built-up member typically used as a beam.

STRETCHER Masonry unit laid with its length horizontal and parallel with the face of the masonry surface.

STRIKE STILE Vertical member of an inactive door leaf which receives the strike.

STRINGER The inclined support member of a stair that supports the risers and treads.

STRIPPING Process of removing the forms from poured concrete after it has hardened.

STRUCTURE That which is built or constructed.

STRUT GUIDE Metal piece attached inside throat of frame which guides and holds ceiling strut to frame (usually incorporated in clip).

STUCCO A type of plaster made from Portland cement, sand, water, and a coloring agent that is applied to exterior walls.

STUDS Vertical structural uprights which make up the walls and partitions in a frame building.

SUB BUCK See Rough Buck.

SUBFLOOR The flooring surface which is laid on the floor joist and serves as a base layer for the finished floor.

SUMP PUMP A pump used to remove water from a sump pit sunk in the basement floor.

SURFACE AIR FILM COEFFICIENT (f) The heat flow in Btu per hour per square foot between an exposed surface and the adjacent air. f1 is inside surface coefficient, f0 is outside surface coefficient. It indicates the conductance of heat through the air film that clings to all surfaces. Film resistance is preferably expressed as 1/f.

SURFACE Reinforcing or machining or both, for hardware which is applied to surface of door or frame in Preparation field.

SURFACED LUMBER Lumber that has been smoothed on at least one side.

SUSPENDED CEILING Ceiling hung below the underside of a floor or a roof. Wire hung channel sections are commonly used to support the finished ceiling material.

SWALE A recessed area formed in the ground to help divert ground water away from a structure.

SWEATED JOINT A manner of joining copper tubing using heat and solder.

TACK WELD A weld made to hold parts of a weldment in proper alignment until the final welds are made.

TEE JOINT In welding, a joint between two members located at approximately right angles to each other in the form of a T.

TEMPERATURE REINFORCING Steel reinforcing used to control cracking due to shrinkage of the concrete mass; usually placed perpendicular to the main reinforcing.

TEMPLATE A pattern used in the steel fabrication shop to locate holes for connectors (bolts).

TENDONS Steel used to induce stress in prestressed concrete; produced as wires, bars, and strands (cable like units made of several wires)

TENSILE STRENGTH The resistance of a material or beam to the tendency to stretch.

TENSION Force or stress in a material caused by pulling action, which tends to create a lengthening of the material.

TERMITE SHIELD A strip of sheet metal used at the intersection of concrete and wood surfaces near ground level to prevent termites from entering the wood.

TERMITES Wood devouring white ants.

TERRA-COTTA Hard-baked clay typically used as a liner for chimneys.

TERRAZZO A floor topping made of marble chips set in cement mortar and ground smooth and polished.

THERM A unit of 100,000 Btu of heat.

THERMAL CONDUCTANCE (C OR 1/R) The reciprocal of Thermal Resistance. "C" has been the unit expressing heat flow in Btu's per hour per square foot of a given thickness for one degree F temperature difference between its surfaces. While it has been used for comparing insulating efficiencies of materials and constructions of several materials of stated thicknesses, it is recommended that it be replaced by Thermal Resistance, R, to simplify calculations. Conductances of a series of materials must not be added.

THERMAL CONDUCTIVITY (k or 1/r) The reciprocal of Thermal Resistivity. "k factor" has been the unit expressing heat flow in Btu's per hour, through one square foot of material which is exactly one inch thick for one degree F difference between its surfaces. While it has been used for comparing insulating efficiencies of homogenous materials (uncoated solid insulation, wood, building board) it is recommended that Thermal Resistivity (r) be used to simplify calculations. Thermal conductivities of a series of materials must not be added.

THERMAL RESISTANCE (R) A unit for the rate of heat flow through a given thickness of a homogeneous or composite material. or construction assembly with or without cavities or reflective surfaces. It is measured by the temperature difference in degrees F between the two exposed faces required to cause one Btu to flow through one square foot per hour. Resistances may be added. (R = temp. diff. F/Btu for one sq. ft, hr).

THERMAL RESISTIVITY (r) A unit for the rate of heat flow through a homogeneous material exactly one inch thick. It is measured by the temperature difference in degrees F between the smooth parallel faces required to cause one Btu to flow through one square foot per hour. Resistivities may be added. (r = temp. diff. F/Btu inch for one sq. ft., hr).

THERMOSTAT A heat sensitive device which is mounted in the living space and which controls the turning on and off of the heating plant.

THRESHOLD The beveled member directly under a door.

TIC MARK The hatch mark or marks on a drawing raceway symbol, showing the number of electrical wires.

TIE (*Masonry veneer*) A metal strip used to tie the masonry wall to the wood sheathing. (*Concrete form work*) Devices used to tie the two sides of a form together.

TILT-UP CONSTRUCTION Method of precasting concrete wall members horizontally on the ground and lifting them (or tilting them up) to their final vertical position.

TIMBER Structural lumber larger than 4 X 6.

TOENAIL Nails driven into a member at an angle.

TONGUE AND GROOVE A joint where the edge of one member fits into a groove in the next member.

OP/BOTTOM CAP Horizontal channel used in doors which do not have a flush top or bottom.

TOTAL THERMAL RESISTANCE (RT) An expression of the total resistance to heat flow through a complete building section or construction assembly, including internal air spaces with or without emittances or reflectances, and external air films. Total thermal resistance is usually expressed as RT of typical section per sq. ft. hr. and value for one construction may be compared directly with another on the basis of more or less heat flow for the same temperatures.

TRANSIT A surveyor's instrument used by builders to establish points and elevations. The transit operates in both the horizontal and vertical planes.

TRANSITION PIECE A sheet metal device shaped to form a transition from one shaped duct to another shaped duct.

TRANSOM BAR The part of a transom frame which separates the top of the door from the transom.

TRANSOM Small window above a door or other window.

TRAP A U-shaped pipe below plumbing fixtures which holds water to prevent odor and ewer gas from entering the fixture.

TREAD The horizontal board in a stair on which a person walks.

TRIM (1) See face. (2) An applied face.

TRIMMED OPENING See Cased Opening.

TROMBE WALL A thermal storage wall that absorbs heat from solar radiation and, in turn, radiates the heat to interior spaces; also used to heat air that passes over the heated surface of the wall in a forced air system.

TRUSS A framework made in triangular-shaped segments used for spanning distances greater than is possible using standard components and methods.

TWO-WAY SLAB Concrete floor or roof slab in which the structural reinforcing steel is placed in two perpendicular directions.

ULTIMATE LOAD Maximum load that can be applied to a member before failure occurs.

ULTIMATE STRENGTH Generally used in reference to the testing of structural materials. The maximum stress obtained when the material is loaded to failure.

UNIFORM LOAD See distributed load.

VALLEY The internal corner formed between two intersecting roof surfaces.

VAPOR BARRIER A material which does not readily permit passage of water vapor. Normally, an acceptable material is rated at one perm or preferably less in many building applications.

VAPOR PERMEABILITY A property of a material measured by the amount of water vapor (grains per square foot per hour for one inch of mercury pressure difference) which passes through an inch-thickness. Unit perm-inch.

VAPOR PERMEANCE Similar to vapor permeability except that permeance, like conductance, is a performance of the material as tested or used regardless of thickness. Unit Perm, is usually the unit of concern to designers.

VAPOR PRESSURE The pressure created by water vapor in a space, whether air is present or not. Saturated vapor pressure is determined only by temperature.

VAPOR RESISTANCE The reciprocal (1/perm) of vapor permeance. A rating of the resistance of a material or an assembly to the passage of water vapor. Unit Rep. In a series, reps may be added.

VAPOR RESISTIVITY Similar to vapor resistance except that it is a rating of a material exactly one inch thick. Unit Rep/inch.

VAULT An inclined ceiling area.

VENEER A facing attached to a wall for the purpose of providing ornamentation, protection, or insulation, but not counted as adding strength to the wall.

VENT PIPE A small ventilating pipe extending from each fixture to the vent stack.

VENT STACK A vertical pipe of a plumbing system used to equalize pressure within the system and to vent sewer gases.

VERTICAL OPENING An opening through a floor or a roof.

VIBRATOR Pneumatic or electric tool used in vibrating fresh concrete into forms, during the pouring operation, to reduce or eliminate air voids.

W-SECTION Designation of a wide-flange beam.

WAINSCOT Decorative or protective covering used on the lower portion of a wall.

WALE Horizontal member which holds concrete forms in line and provides a stiffening effect.

WALLBOARD Large flat sheets of gypsum, typically 1/2 to 5/8 in. thick, used to finish interior walls.

WASTE STACK Vertical pipe to carry waste water to house drain.

WATER-CEMENT RATIO The amount (gallons) of water per sack (94 lb) of cement used in making concrete; it is an index to strength, durability, water tightness, and workability.

WATER CLOSET A fixture usually called a toilet.

WATER TABLE The members of wood trim at the bottom of exterior siding designed for finish and to keep water from running down the foundation wall.

WATERPROOF Material or a type of construction that prevents the absorption of water.

WEATHERSTRIP Strips of material that are attached to the edges of doors, windows, and other openings to prevent air flow.

WEB Center portion of an S-section, W-section, or C-section.

WEB MEMBERS Interior members of a truss.

WEEP HOLES Small holes (weeps) near the bottom of masonry walls to allow release of moisture that may accumulate in the walls.

WEEP WICK Short length of small rope placed in weep holes to allow seepage of moisture from masonry walls to the exterior, without having an actual opening.

WEIR A barrier or dam placed across a channel to control or measure the flow of water; many weirs have a restricted opening in the form of a rectangle or a veenotch.

WELDED WIRE FABRIC Steel wires welded together to form a mesh; used for concrete reinforcing, usually slabs.

WELLPOINT A screened perforated tube, usually installed below grade, for dewatering soil. It filters and collects the groundwater from the surrounding soil and allows the water to be siphoned to the surface discharge lines by pumps.

WIND BRACING Diagonal struts, or other members, placed within the structural frame of a building to resist lateral forces caused by wind pressure.

WIND LOADS Lateral forces, due to wind velocity, acting against a building; velocities increase with height above the ground and are especially important in the design of high-rise buildings.

WORK TRIANGLE The triangular area created in the kitchen by drawing a line from the sink, to the refrigerator, and to the cooking area.

WORKABILITY Relative ease or difficulty with which concrete can be placed and worked into its final position within forms and around reinforcing.

WORKING LOADS Those vertical forces that are expected to act on a building; used in the structural design of building components and usually designated by building codes.

WYTHE A continuous vertical section of masonry, one unit in thickness.

YIELD POINT The stress at which material begins to deform without any additional stress being applied during tension (or compression) testing; a physical phenomenon exhibited by low-to medium-high-carbon steels.

YIELD STRENGTH The stress obtained by a specified offset strain for material having no well-defined yield point; a computed value exhibited by high-carbon steel, various steel alloys, aluminum, and other materials.

YIELD STRESS A general term used to refer to either yield point or yield strength in material specifications or designations.

ABBREVIATIONS

ABBREVIATIONS

The following listed abbreviations are commonly found in the drawings, and may also occur in other Contract Documents. Additional abbreviations or modifications to the listed ones are schedules on the drawings, whenever used.

TERM	ABBREV.
above	ABV.
above finished floor	A.F.F.
access door	A.D.
access panel	A.P.
acid resisting	A.R.
acoustic	AC.
acoustic plaster	AC.PL.
acoustical	ACOUS.
acoustical tile	A.T.
acoustical tile w/washable fin.	A.T.Z.
actual	ACT.
addition	ADDN.
adhesive	ADH.
adjacent	ADJ.
adjustable	ADJ.
adjustable shelves	A.S.
aggregate	AGG.
air conditioning	A.C.
air handling	A.H.
alternate	ALT.
aluminum	ALUM.
American Institute of Architechts	A.I.A.
American Institute of Building Designers	A.I.B.D.
American Institute of Steel Construction	A.I.S.C.
American Institute of Timber Construction	A.I.T.C.
American National Standards Institute	A.N.S.I.

TERM	ABBREV.
American Plywood Association	A.P.A.
American Society for Testing and Materials	A.S.T.M.
American Society of Civil Engineers	A.S.C.E.
American Society of Heating, Refrigerating, and Air Conditioning Engineers	A.S.H.R.A.E.
American Society of Landscaping Architects	A.S.L.A.
American Society of Mechanical Engineers	A.S.M.E.
amount	AMT.
ampere	AMP.
anchor bolt	A.B.
anchor(age)	ANC.
and	&
angle	∠
anodized	ANOD.
apartment	APT.
approved	APPD.
approximate	APPROX.
architect	ARCHT.
architectural	ARCH.
area	A.
area drain	A.D.
asbestos	ASB.
asbestos board	A.B.
asphalt	ASPH.
asphalt tile	A.T.
asphaltic concrete	ASPH.CONC.
at	@
automatic	AUTO.
automotive air valve	A.A.U.
avenue	AVE.
average	AVG.

TERM	ABBREV.
backflow preventer	B.P.
balcony	BALC.
balled & burlapped	B.&B.
bare rotted	B.R.
basement	BSMT.
Basic National Building Code	B.O.C.A.
bath tub	B.T.
bathroom	BATH.
batten	BATT.
beam	BM.
bearing	BRNG.
bearing plate	BPL. or BRG. PL.
bedroom	BR.
benchmark	B.M.
bending moment	"M"
better	BTR.
between	BTW.
beveled	BVL. or BEV.
bidet	BDT.
bituminous	BITUM.
block	BLK.
blocking	BLKG.
blower	BLO.
blueprint	BP.
board	BD.
board feet	BD.FT.
boiler	BLR.
bolt	BT.
book shelves	B.S.
both sides	B.S.
both ways	B.W.

TERM	ABBREV.
bottom	BTM.
bottom of curb	B.C.
bottom of footing	B.F.
bottom of wall	B.W.
boulevard	BLVD.
brass	BRS.
brick	BRK.
British Thermal Unit	B.T.U.
bronze	BRZ.
broom closet	BC.
building	BLDG.
building line	B.L.
built-in	BLT-IN.
built up roof	B.U.R.
bulletin board	B.B.
buzzer	BUZ.
by	X
cabinet	CAB.
carpet	CPT
casing	CSG.
cast concrete	C.CONC.
cast-in-place	C.I.P.
cast iron	C.I.
cast stone	C.ST. or C.S.
catalog	CAT.
catch basin	C.B.
caulk	CLK.
caulking	CLKG. or CALK.
ceiling	CLG.
ceiling diffuser	C.D.
ceiling joist	C.J. or CEL.JST.

TERM	ABBREV.
cellar	CEL.
cement	CMT.
cement asbestos board	CEM.A.B.
cement floor	CMT. FLR.
cement mortar	CMT. MTR.
cement plaster	CMT. PLAS.
center	CTR.
center line	C.L. or C.
center matched	C.M.
center to center	C. to C.
centered	CTRD.
ceramic	CER.
ceramic tile	C.T.
chalk board	C.B.
chamfer	CHAM.
channel	CHAN. or C.
check	CHK.
chilled water	CH.W.
cinder block	CIN.BLK.
circle	CIR.
circuit	CKT.
circuit breaker	CKT.BKR.
circulating	CIRC.
class	CL.
cleanout	C.O.
cleanout door	C.O.D.
cleanout in wall	C.O.I.W.
cleanout through floor	C.O.T.F.
cleanout through wall	C.O.T.W.
clear	CLR.
clear glass	CLR.GLS.

TERM	ABBREV.
clear wire glass	CLR.W.GLS.
closet	CLO.
coat closet	C.CLO.
coat hook	C.H.
coat rack	C.R.
cold air	C.A.
cold water	C.W.
collar beam	COL.B.
column	COL.
combination	COMB.
common	COM.
compartment	COMPT.
composition	COMP.
concrete	CONC.
concrete block	CONC.BLK.
concrete floor	CONC.FL.
concrete masonry unit	C.M.U.
condensation	CONDS.
conduit	CND.
connection	CONN.
construction	CONST.
construction joint	CONST.JT.
continuation	CONT.
continuous	CONT.
contract	CONT.
contractor	CONTR.
control joint	C.J.
coordinate	COORD.
copper	COP.
corner	COR.
corner guard	C.G.

TERM	ABBREV.
corridor	CORR.
corrugated	CORRUG.
counter	CNR.
counter flashing	CTR.FLSG.
counter sink	C.S.
countersink	CSK.
countersunk screw	CSK.S.
countersunk wood screw	CSK.W.S.
course or courses	CRS.
cover	COV.
cubic	CU.
cubic feet	C.F. or CU.FT.
cubic feet per minute	C.F.M.
cubic yards	C.Y. or CU.YD.
cut out	C.O.
damp proofing	D.PRF.
damper	DPR.
dead load	D.L.
decibel	DB.
decking	DK.
deep	DP.
deformed anchor stud	D.A.S.
degree	DEG. or (°)
demolish, demonolition	DEMO.
department	DEPT.
detail	DET.
diagonal	DIAG.
diagram	DIAG.
diameter	DIA./DIAM. or (0)
diffuser	DIFF.
dimension	DIM.

TERM	ABBREV.
dimmer	DIM.
dining room	D.R.
direct current	D.C.
discharge	DISCH.
dishwasher	DW.
disposal	DISP.
ditto	DO. OR "
divided	DIV.
division	DIV.
door	DR.
double	DBL.
double acting	DBL.ACT.
double hung	D.H.
double-hung window	D.H.W.
double strength glass	D.S.G.
Douglas fir	D.F.
dovetail	DVTL.
dowel	DWL.
down	DN.
downspout	D.S.
dozen	DOZ.
drain	D.
drawer	DWR.
drawing	DWG.
dressed and matched	D. & M.
drinking fountain	D.F.
drip cap	D.C.
dry standpipe	D.SP.
dryer	DRY.
drywall	D.W.
dummy joint	D.J.

TERM	ABBREV.
duplex	DUP.
each	EA.
each face	E.F.
each way	E.W.
east	E.
elbow	EL.
electric	ELEC.
electric metallic tubing	E.M.T.
electric operator	ELECT.OPR.
electric panel	E.P.
electric water cooler	E.W.C.
electrical	ELECT.
elevation	EL.
elevator	ELEV.
embedment	EMBED.
emergency	EMER.
enamel	EN.
enamelized marking board	E.M.B.
enclosure	ENCL.
end to end	E. to E.
engineer	ENGR.
entrance	ENT.
equal	EQ.
equipment	EQUIP.
estimate	EST.
excavate	EXC.
exhaust	EXH.
exhaust fan	E.F.
existing	EXIST.
expansion	EXP.
expansion bolt	EXP.B.

TERM	ABBREV.
expansion joint	EXP.J.
explanation	EXP.
exposed	EXPO.
exposed aggregate	E.A.
extension	EXTN.
exterior	EXT.
exterior grade	EXT.GR.
exterior insulation wall system	E.E.W.S.
fabricate	FAB.
face brick	F.B.
face of brick	F.O.B.
face of concrete	F.O.C.
face of finish	F.O.F.
face of masonry	F.O.M.
face of stud	F.O.S.
face of wall	F.O.W.
Fahrenheit	F.
far face	F.F.
Federal Housing Administration	F.H.A.
feet / foot	' or FT.
feet per minute	F.P.M.
feet per second	F.P.S.
figure	FIG.
finish	FIN.
finished floor	FIN.FLR.
finished floor line	F.F.L.
finished grade	FIN.GR.
finished opening	F.O.
fire alarm	F.A.
fire department connection	F.D.C.
fire extinguisher	F.E.

TERM	ABBREV.
fire extinguisher cabinet	F.E.C.
fire hose cabinet	F.H.C.
fire hydrant	F.H.
firebrick	FBRK.
fireplace	FPL. or FRPL.
fireproof	FP. or FRPF.
fixed window	FX.WDW.
fixture	FIX.
flammable	FLAM.
flange	FLG.
flashing	FLSG.
flat bar	F.B.
flat grain	F.G.
flat head	F.H.
flat headed screw	F.H.S.
flat headed wood screw	F.H.W.S.
flexible	FLEX.
float glass	F.GL.
floor	FLR.
floor drain	F.D.
floor joist	FLJST.
floor sink	FLSK.
flooring	FLRG.
fluorescent	FLUR. or FLUOR.
flush	FL.
folding	FLDG.
foot (feet)	FT. or (')
footing	FTG.
forced air unit	F.A.U.
foundation	FND.
frame	FR.

TERM	ABBREV.
framing	FRMG.
front	FNT.
full size	F.S.
furnace	FURN.
furring	FUR.
future	FUT.
gage	GA.
gallon	GAL.
gallons per hour	G.P.H.
gallons per minute	G.P.M.
galvanized	GALV.
galvanized iron	G.I.
galvanized steel	GALV.STL.
garage	GAR.
gas	G.
gauge	GA.
general	GEN.
girder	GIRD.
glass	GL.
glass block	GLB. or GL.BL.
glass enclosed bulletin board	GL.B.B.
glazed masonry unit	G.M.U.
glu-laminated beam	G.L. or GLU.LAM.
grab bar	G.B.
grade	GR.
grade beam	GR.BM.
grade line	GR.L.
grating	GRTG.
gravel	GVL.
grille	GRL.
ground	GND.

TERM	ABBREV.
grout	GT.
gypsum	GYP.
gypsum board	GYP.BD.
gypsum wall board	G.W.B.
gypsum wall board moisture-res.	G.W.B.-MR.
hardboard	HDB.
hardware	HDW.
hardwood	HDWD.
head	HD.
headed anchor bar	H.A.B.
headed anchor stud	H.A.S.
header	HDR.
heater	HTR.
heating	HTG.
heating & ventilation	H. & V.
heating, ventilating, air conditioning	H.V.A.C.
height	HT.
hemlock	HEM.
hemlock-fir	HEM.-FIR.
high	H.
high point	H.PT.
high strength bolt	H.S.B.
hollow core	H.C.
hollow metal	H.M.
hollow metal door	H.M.D.
hollow metal frame	H.M.F.
horizontal	HORZ.
horsepower	H.P.
hose bibb	H.B.
hot air	H.A.
hot water	H.W.

TERM	ABBREV.
hot water heater	H.W.H.
hot water recirculation	HWR.
hour	HR.
illuminate	ILLUM.
incandescent	INCAN.
inch	IN. or (")
include	INCL.
indirect waste	I.W.
inflammable	INFL.
inside diameter	I.D.
inside face	I.F.
inspection	INSP.
install	INST.
insulate glass	I.GL.
insulated	INSUL.
insulation	INS.
interior	INT.
International Conference of Building Officials	I.C.B.O.
invert elevation	INV.EL.
iron	I.
irrigation	IRRI.
isometric	ISO.
jamb	JB. or JMB.
janitor	JAN.
joint	JT.
joist	JST.
junction	JCT.
junction box	J-BOX
keyed kold joint	K.K.J.
kick plate	K.PL.

TERM	ABBREV.
kiln-dried	K.D.
kilogram	KG.
kilometer	KM.
kilowatt	KW.
kip (1,000 lb)	K.
kitchen	KIT.
knock out	K.O.
laboratory	LAB.
lag bolt	L.B.
laminate	LAM.
laminate translucent mirror	LT.M.
landing	LDG.
lath	LTH.
laundry	LAUN.
lavatory	LAV.
leader	LDR.
leader drain	LDR.DRN.
length	L.
length over all	L.O.A.
level	LEV.
library	LIB.
light	LT.
limestone	LMS. or LS.
line	L
lineal	LIN.
linear feet	LIN.FT.
linen closet	L.CL.
lining	LN.
linoleum	LINO.
live load	L.L.
living room	L.R.

TERM	ABBREV.
locker	LKR.
long	LG.
long leg horizontal	L.L.H.
long leg vertical	L.L.V.
louver	LVR.
low point	L.P.
lumber	LBR.
machine	MACH.
machine bolt	M.B.
mail boxes	M.B.
main	MN.
manhole	M.H.
manufactured	MFD.
manufacturer	MFR.
marble	MRB.
masonry	MAS.
masonry opening	M.O.
material	MATL. or MAT.
maximum	MAX.
mechanical	MECH.
medicine cabinet	M.C.
medium	MED.
member	MBR.
membrane	MEMB.
metal	MTL. or MET.
meter (measure)	M.
mezzanine	Mezz.
mile	MI.
minimum	MIN.
mirror	MIR.
miscellaneous	MISC.

TERM	ABBREV.
mixture	MIX.
modular	MOD.
modulus of elasticity	"E"
monument	MON.
mortar	MOR.
moulding	MLD. or MLDG.
mounted	MTD.
mullion	MULL.
muntin	MUNT.
National Association of Home Builders	N.A.H.B.
National Bureau of Standards	N.B.S.
natural	NAT.
natural grade	NAT.GR.
near face	N.F.
neck	NK.
noise reduction coefficient	N.R.C.
nominal	NOM.
normally closed	N.C.
normally open	N.O.
north	N.
nosing	NOS. or NSG.
not applicable	N.A.
not in contract	N.I.C.
not to scale	N.T.S.
number	NO. or #
obscure	OBS.
obscure glass	OBSC.GL.
office	OFF.
on center	O.C.
open web joist	O.J.
opening	OPG.

TERM	ABBREV.
opposite	OPP.
opposite hand	OPP.H.
ounce	OZ.
out to out	O. to O.
outlet	OUT.
outside air	O.S.A.
outside diameter	O.D.
oval headed screw	O.H.S.
oval headed wood screw	O.H.W.S.
overall	O.A.
overflow drain	O.F.D.
overflow leader	O.F.F.
overhead	OH. or OVHD.
overhead door	OH.D.
paint	P.
painted	PTD.
pair	PR.
panel	PNL.
pantry	PAN.
paper towel dispenser	P.T.D.
paper towel dispenser & receptacle	P.T.D.R.
paper towel receptacle	P.T.R.
parallel	// or PAR.
partition	PTN. or PART.
pavement	PVMT.
penny (nail size)	d/
per	/
per square inch	P.S.I.
perforated	PERF.
perpendicular	PERP. OR ⊥
plant bed	P.B.

TERM	ABBREV.
plaster	PLAS. or PLS.
plaster board	P.B. or PLS.BD.
plaster veneer	P.V.
plastered opening	P.O.
plastic	PLAS.
plastic laminate	P.LAM.
plate	PL. or
plate glass	PG. or PL.GL.
plate height	PL.HT.
platform	PLAT.
plumbing	PLBG. or PLMB.
plywood	PLY. or PLY.WD.
point	PT.
point of curvature	P.C.
point of intersection	P.I.
polished	POL.
polyethelyne	POLY.
polyvinyl chloride	P.V.C.
porch	P.
position	POS.
post indicator valve	P.I.V.
pound	LB. or (#)
pounds per square foot	P.S.F.
pounds per square inch	P.S.I.
powder driver fastener	P.D.F.
precast	PRCST.
precast concrete	P.C.
prefabricated	PREFAB.
prefinish(ed)	PREFIN.
preliminary	PRLIM.
pressure	PRESR.

TERM	ABBREV.
pressure reducing valve	P.R.V.
pressure treated	P.T.
projection screen	P.S.
property	PROP.
property line	P/L or P.L.
pull chain	P.C.
pull switch	P.S.
purified cold water	P.C.W.
pushbutton	P.B.
quality	QTY.
quarry tile	Q.T.
rad	(R)
radiator	RAD. or R.
radius	R. or RAD.
rain water leader	R.W.L.
random	RDM.
random length & width	R.L.&W.
range	R.
receptacle	RECP.
recessed	REC.
recirculation	RECIRC.
redwood	RDWD.
reference	REF.
reflected	REFL.
refrigerator	REF.
register	REG.
reinforced concrete pipe	R.C.P.
reinforcing	RENF.
reinforcing bar	REBAR.
reinforcing steel bar	REBAR.
relief fan	R.F.

TERM	ABBREV.
remove	RMV.
required	REQ'D.
resilient	RESIL.
return	Ret.
return air	R.A.
revision	REV.
revolutions per minute	R.P.M.
ridge	RDG.
right of way	R.O.W.
risers	RS. or RIS.
roof	RF.
roof drain	R.D.
roof drain, overflow	R.D.O.
roofing	RFG.
room	RM. or R.
rough	RGH.
rough opening	R.O.
round	RD. or Ø
rubber	RUB.
rubber tile	RB.T. or R. TILE
S beam	S.BM.
saddle	SDL. or S.
sand blast	S.B.
sanitary	SAN.
sanitary napkin dispenser	S.N.D.
sanitary napkin receptale	S.N.R.
scale	SC.
schedule	SCH.
screen	SCN. or SCR. or SCRN.
screw	SCR.
scuttle	S.

TERM	ABBREV.
seat cover dispenser	S.C.D.
second	SEC.
section	SECT.
select	SEL.
select structural	SEL.ST.
self-closing	S.C.
service	SERV.
service sink	S.S.K.
sewer	SEW.
sheathing	SHTG. or SHTHG.
sheet	SHT.
sheet metal	S.M.
sheet metal screw	S.M.S.
sheeting	SHT'G. or SHTG.
shelf and pole	S. & P.
shelf and rod	SH. & RD.
shelving	SH. or SHELV.
shiplap	SHLP.
shower	SHWR. or SH.
siding	SDG.
sill cock	S.C.
similar	SIM.
single hung	S.H.
single strength glass	SSG.
singular	SIN.
sink	SK.
slab joint	S.J.
sliding door	SL.DR. or SLDG.DR.
soap & grab	S. & G.
soap dispenser	S.D.
socket	SOC.

TERM	ABBREV.
soft water	S.W.
soil pipe	S.P.
solid block	SOL.BLK.
solid core	S.C.
south	S.
Southern Building Code	S.B.C.
Southern pine	S.P.
Southern Pine Inspection Bureau	S.P.I.B.
specifications	SPEC.
spread	SPR.
sprinkler	SPKLR.
spruce-pine-fir	S.P.F.
square	SQ. or
square foot	SQ.FT.
square inch	SQ.IN.
staggered	STAG.
stained	STN.
stained-waxed	S.W.
stainless steel	S.S.
stairs	ST.
stairway	STWY.
stand pipe	ST.P.
standard	STD.
standard wire gauge	S.W.G.
station	STA.
steel	STL.
steel sash	S.S.
steem	STM.
stiffener	STIFF.
stirrup	STIR.
stock	STK.

TERM	ABBREV.
stone	STN.
storage	STOR.
storage cabinet	S.C.
store front	S.F.
storm drain	S.D.
street	ST.
structural	STR.
Structural Clay Products Research Foundation	SCR.
structural clay tile	S.C.T.
substitute	SUB.
supply	SUP.
supply fan	S.F.
surface	SUR.
surface four sides	S4S
surface two sides	S2S
suspend	SUSP.
suspended ceiling	SUSP. CLG.
switch	SW.
symbol	SYMB.
symmetrical	STM.
synthetic	SYN.
system	SYS.
tangent	TAN.
tectum	TECT.
tee	T.
telephone	TEL.
television	TV.
temperature	TEMP.
tempered	TEMP.
tempered plate glass	TEM.PL.GL.

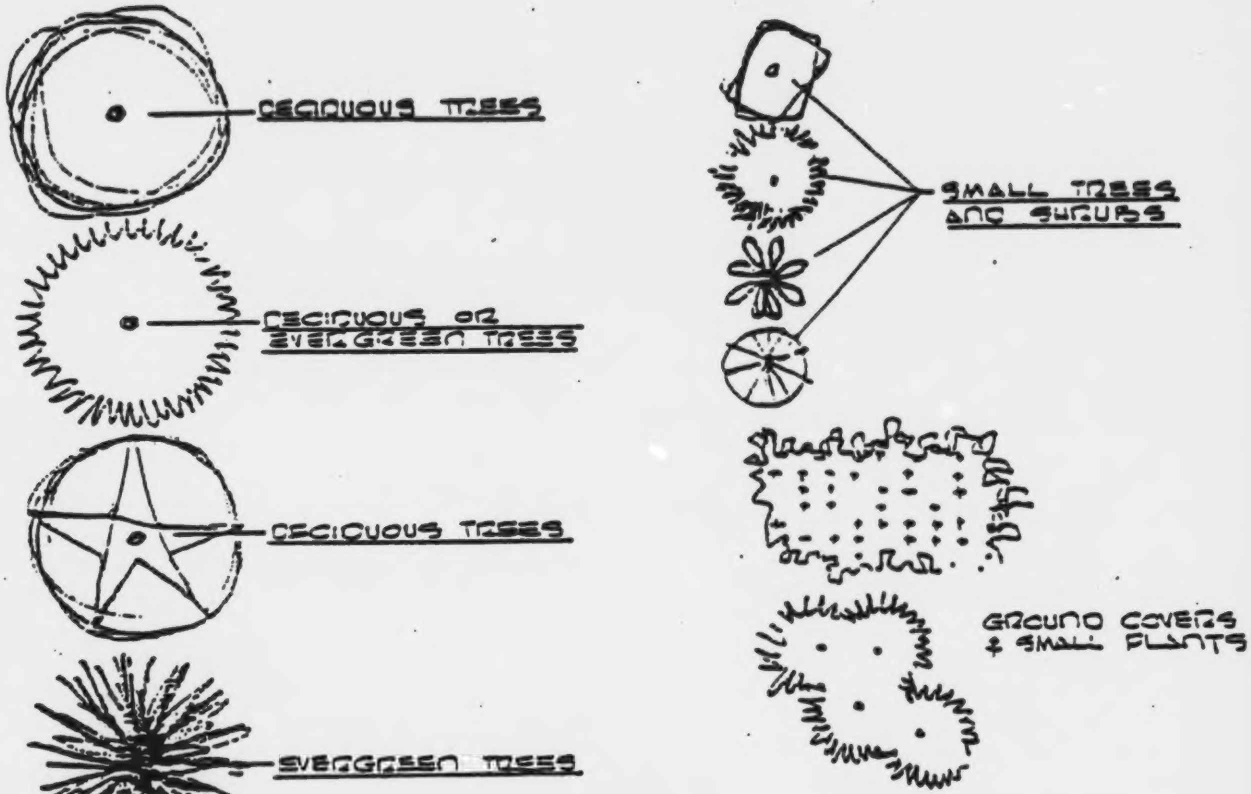
TERM	ABBREV.
temporary	TEMPOR.
terra cotta	T.C.
terrazzo	TZ. or TER.
thermal conductance	"C"
thermal conductivity	"K"
thermostat	T-STAT.
thick or thickness	THK.
thousand board feet	M.B.F. or M̶
threaded	THRD.
threshold	THRES. or THR.
through	THRU.
to match existing	T.M.E.
toilet	T. or TOL. or TLT.
toilet paper dispenser	T.P.D.
toilet paper holder	T.P.H.
tongue and groove	T. & G.
top of all	T.W.
top of curb	T.C.
top of footing	T.F.
top of pavement	T.P.
top of wall	T.W.
towel bar	T.B.
transom	TRN.
treads	TR.
treated wood	TRT. WD.
typical	TYP.
Underwriters' Laboratories, Inc.	U.L.
unexcavated	UNEXC.
unfinished	UNF. or UNFIN.
Uniform Building Code	U.B.C.

TERM	ABBREV.
United States Department of Housing and Urban Development	H.U.D.
unless noted otherwise	U.N.O.
unless otherwise noted	U.O.N.
urinal	UR.
utility	UTIL.
utility room	U.RM. or UTIL.RM.
V-joint	V-JT.
vanishing point	V.P.
vanity	VAN.
vapor barrier	V.B.
vent	V. or VENT.
vent stack	V.S.
vent thorugh roof	V.T.R.
vent through roof	V.T.R.
ventilation	VENT.
verify	VER.
vertical	VERT.
vertical grain	V.G. or VERT.GR.
vestibule	VEST.
vibration	VIB.
vinyl	VIN.
vinyl asbestos tile	V.A.T.
vinyl base	V.B.
vinyl composition tile	V.C.T.
vinyl tile	V.T. or V. TILE
vitreous clay tile	VIT. TILE or V.C.T.
volume	VOL.
wainscot	WSCT. or WAIN.
wall hung	W.H.
wall panel	W.P.

TERM	ABBREV.
wall vent	W.V.
warm air	W.A.
washing machine	W.M.
waste	W.
waste stack	W.S.
water	W.
water closet	W.C.
water heater	W.H.
water resistant	W.R.
waterproof	WP.
waterproofing	W.PRFG.
watt	W.
waxed	WX.
weather stripping	W.S.
weatherproof	WEA.PRF.
weephole	WH.
weight	WT.
weld stud	W.S.
welded wire fabric	W.W.F.
welded wire mesh	W.W.M.
west	W.
wet stand pipe	W.S.P.
wheelchair ramp	WC.R.
white pine	W.P.
whiteboard	W.B.
wide flange	W. or WF.
width	W. or WTH.
window	WIN. or WDW.
wire glass	W.GL.
with	W/
without	W/O

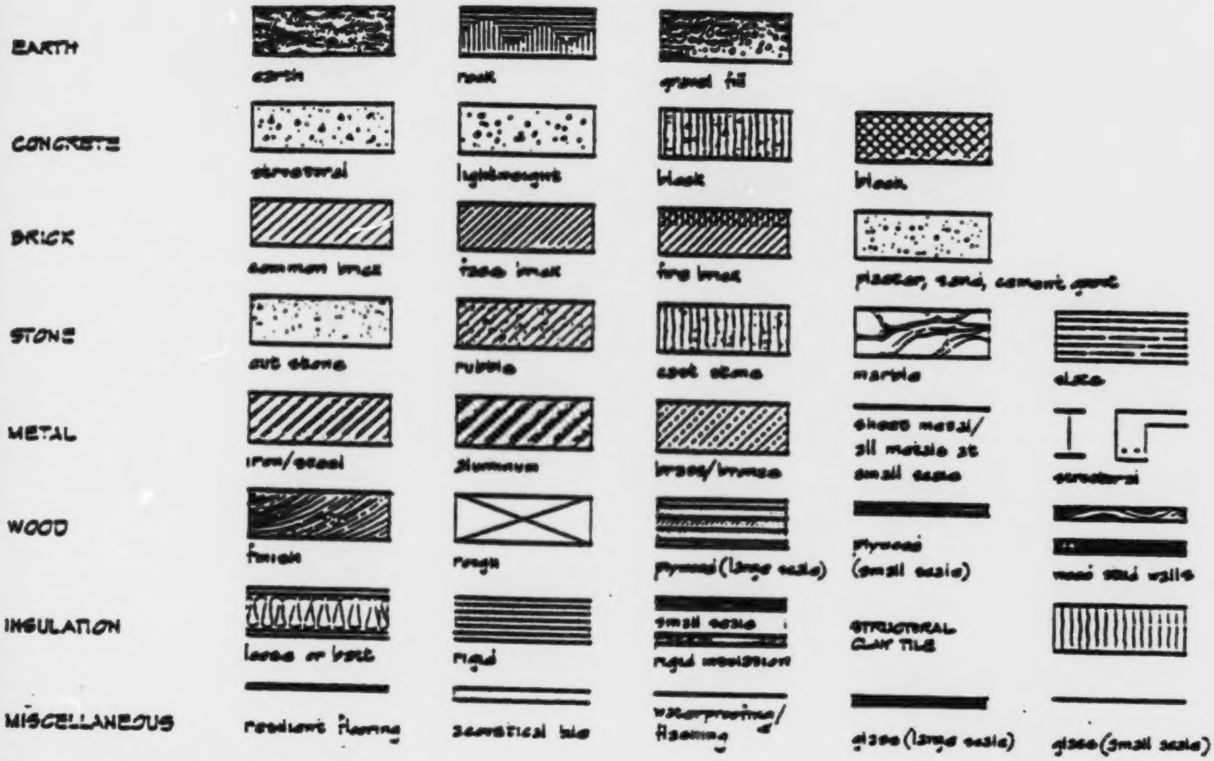
TERM	ABBREV.
wood	WD.
wood frame	W.F.
work point	W.P.
woven wore mesh	W.W.M.
wrought iron	W.I.
yard	YD.
yard drain inlet	Y.D.I
year	YR.
yellow pine	YP.
zinc	Z. or ZN.

SYMBOLS

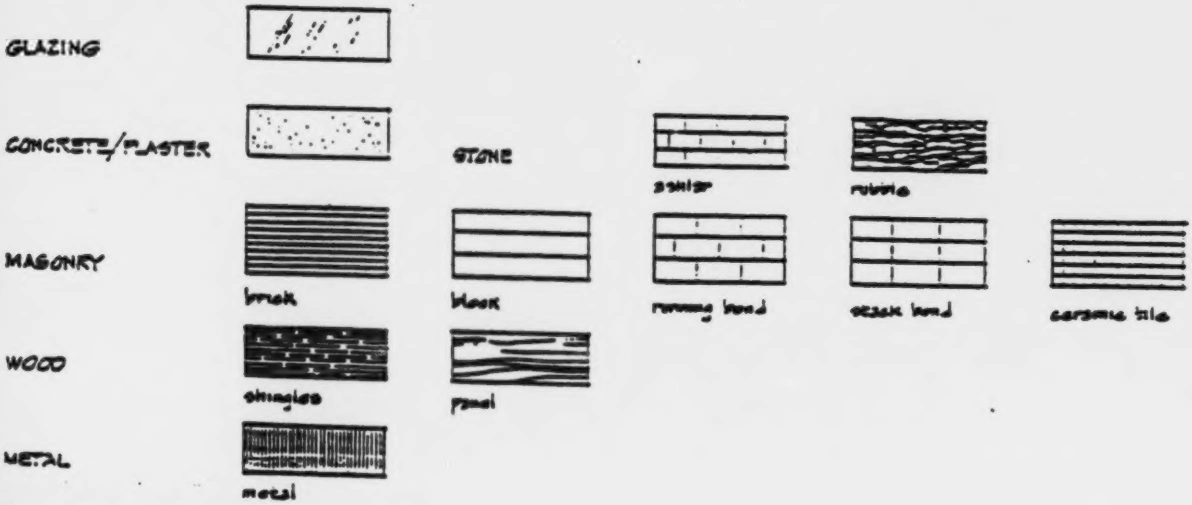

DECIDUOUS TREES
DECIDUOUS OR EVERGREEN TREES
DECIDUOUS TREES
EVERGREEN TREES
SMALL TREES AND SHRUBS
GROUND COVERS & SMALL PLANTS

PLANTS ARE DRAWN TO THE APPROXIMATE MATURE SCALE

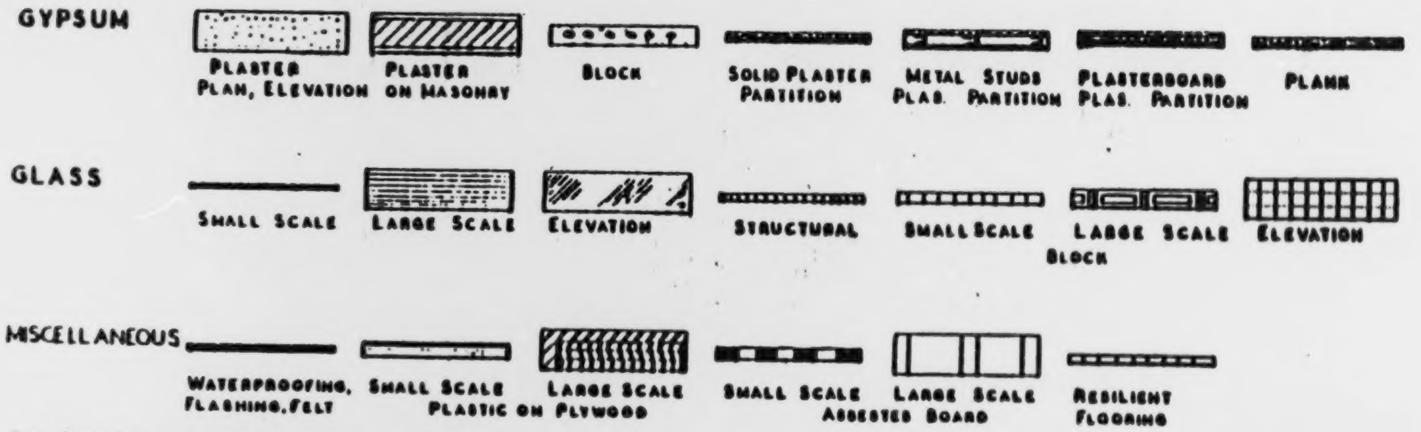
These symbols are some of the abstract conventions commonly used in architectural construction drawings.


EARTH
earth
rock
gravel fill
CONCRETE
structural
lightweight
block
block
BRICK
common brick
face brick
fire brick
plaster, sand, cement grout
STONE
cut stone
rubble
cast stone
marble
slate
METAL
iron/steel
aluminum
brass/bronze
sheet metal/
all metals at
small scale
structural
WOOD
finish
rough
plywood (large scale)
plywood
(small scale)
wood stud walls
INSULATION
loose or batt
rigid
small scale
rigid insulation
STRUCTURAL
CLAY TILE
MISCELLANEOUS
resilient flooring
acoustical tile
waterproofing/
flashing
glass (large scale)
glass (small scale)

• PLAN AND SECTION INDICATIONS


GLAZING
CONCRETE/PLASTER
STONE
ashlar
rubble
MASONRY
brick
block
running bond
stack bond
ceramic tile
WOOD
shingles
panel
METAL
metal

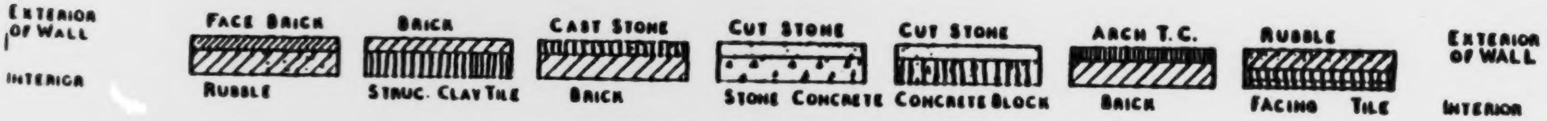
• ELEVATION INDICATIONS


GYPSUM
PLASTER PLAN, ELEVATION
PLASTER ON MASONRY
BLOCK
SOLID PLASTER PARTITION
METAL STUDS PLAS. PARTITION
PLASTERBOARD PLAS. PARTITION
PLANK
GLASS
SMALL SCALE
LARGE SCALE
ELEVATION
STRUCTURAL
SMALL SCALE
LARGE SCALE
BLOCK
ELEVATION
MISCELLANEOUS
WATERPROOFING, FLASHING, FELT
SMALL SCALE
LARGE SCALE
PLASTIC ON PLYWOOD
SMALL SCALE
LARGE SCALE
ASBESTOS BOARD
RESILIENT FLOORING

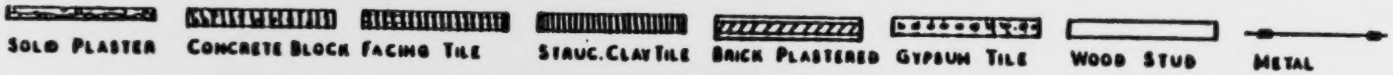
ALL SYMBOLS ARE FOR PLANS AND SECTIONS UNLESS MARKED "ELEVATIONS"

"SYMBOLS", MARKED, APPROVED BY AMERICAN STANDARDS ASSOCIATION

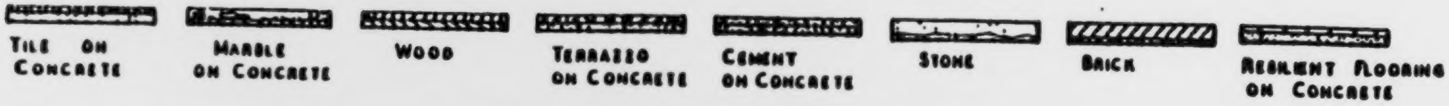
EXAMPLES


EXTERIOR OF WALL
INTERIOR
FACE BRICK
RUBBLE
BRICK
STRUC. CLAY TILE
CAST STONE
BRICK
CUT STONE
STONE CONCRETE
CUT STONE
CONCRETE BLOCK
ARCH T.C.
BRICK
RUBBLE
FACING TILE
EXTERIOR OF WALL
INTERIOR

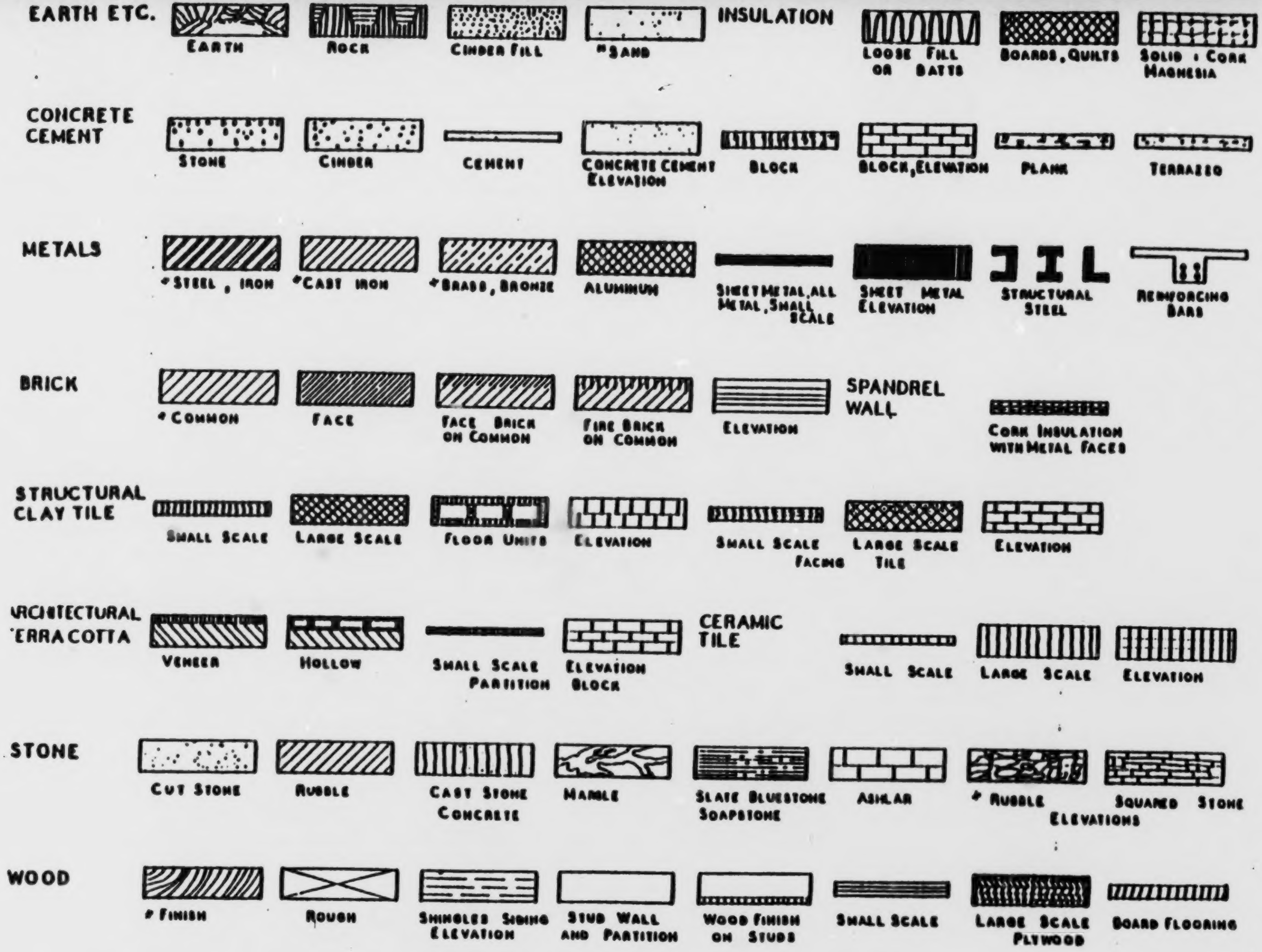
PLANS OF EXTERIOR WALLS

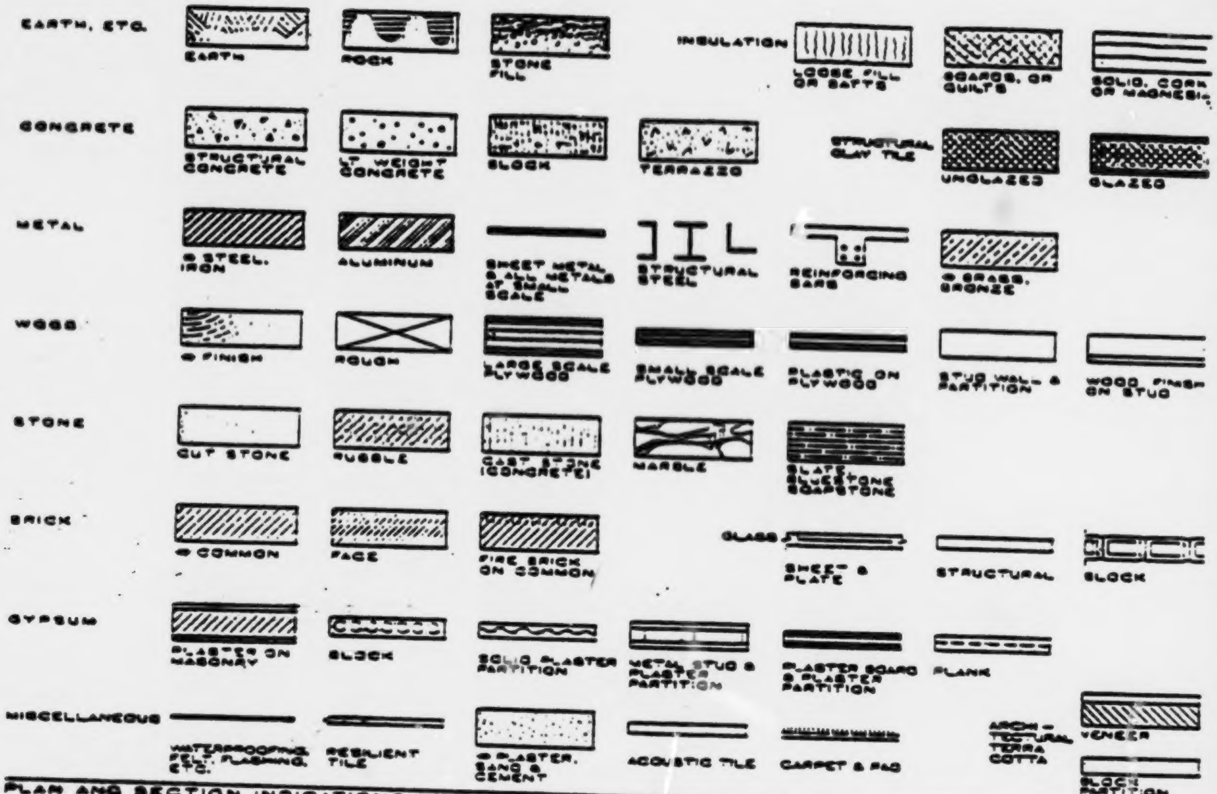

SOLID PLASTER
CONCRETE BLOCK
FACING TILE
STRUC. CLAY TILE
BRICK PLASTERED
GYPSUM TILE
WOOD STUD
METAL

PLANS OF PARTITIONS

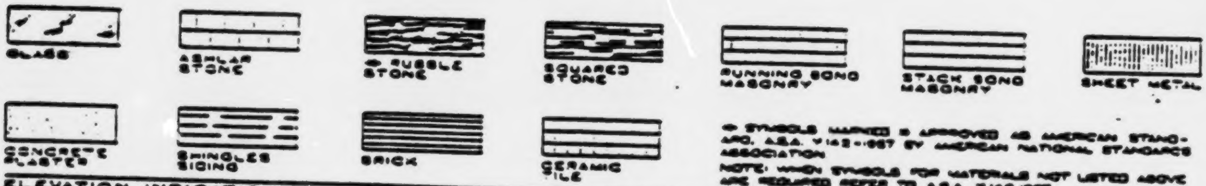

TILE ON CONCRETE
MARBLE ON CONCRETE
WOOD
TERRAZZO ON CONCRETE
CEMENT ON CONCRETE
STONE
BRICK
RESILIENT FLOORING ON CONCRETE

SECTIONS OF FLOOR FINISHES

EARTH ETC.
EARTH
ROCK
CINDER FILL
*SAND
INSULATION
LOOSE FILL OR BATTS
BOARDS, QUILTS
SOLID : CORK MAGNESIA
CONCRETE CEMENT
STONE
CINDER
CEMENT
CONCRETE CEMENT ELEVATION
BLOCK
BLOCK, ELEVATION
PLANK
TERRAZZO
METALS
*STEEL, IRON
*CAST IRON
*BRASS, BRONZE
ALUMINUM
SHEET METAL, ALL METAL, SMALL SCALE
SHEET METAL ELEVATION
STRUCTURAL STEEL
REINFORCING BARS
BRICK
* COMMON
FACE
FACE BRICK ON COMMON
FIRE BRICK ON COMMON
ELEVATION
SPANDREL WALL
CORK INSULATION WITH METAL FACES
STRUCTURAL CLAY TILE
SMALL SCALE
LARGE SCALE
FLOOR UNITS
ELEVATION
SMALL SCALE
LARGE SCALE
FACING TILE
ELEVATION
RCHITECTURAL
ERRACOTTA
VENEER
HOLLOW
SMALL SCALE PARTITION
ELEVATION BLOCK
CERAMIC TILE
SMALL SCALE
LARGE SCALE
ELEVATION
STONE
CUT STONE
RUBBLE
CAST STONE CONCRETE
MARBLE
SLATE BLUESTONE SOAPSTONE
ASHLAR
* RUBBLE
SQUARED STONE
ELEVATIONS
WOOD
* FINISH
ROUGH
SHINGLES SIDING ELEVATION
STUD WALL AND PARTITION
WOOD FINISH ON STUDS
SMALL SCALE
LARGE SCALE PLYWOOD
BOARD FLOORING


EARTH, ETC.
EARTH
ROCK
STONE FILL
INSULATION
LOOSE FILL OR BATTS
BOARDS OR QUILTS
SOLID, CORK OR MAGNESIA
CONCRETE
STRUCTURAL CONCRETE
LT. WEIGHT CONCRETE
BLOCK
TERRAZZO
STRUCTURAL CLAY TILE
UNGLAZED
GLAZED
METAL
* STEEL, IRON
ALUMINUM
SHEET METAL & ALL METALS AT SMALL SCALE
STRUCTURAL STEEL
REINFORCING BARS
* BRASS, BRONZE
WOOD
* FINISH
ROUGH
LARGE SCALE PLYWOOD
SMALL SCALE PLYWOOD
PLASTIC ON PLYWOOD
STUD WALL & PARTITION
WOOD FINISH ON STUD
STONE
CUT STONE
RUBBLE
CAST STONE (CONCRETE)
MARBLE
SLATE BLUESTONE SOAPSTONE
BRICK
* COMMON
FACE
FIRE BRICK ON COMMON
GLASS
SHEET & PLATE
STRUCTURAL
BLOCK
GYPSUM
PLASTER ON MASONRY
BLOCK
SOLID PLASTER PARTITION
METAL STUD & PLASTER PARTITION
PLASTER BOARD & PLASTER PARTITION
PLANK
MISCELLANEOUS
WATERPROOFING, FELT, FLASHING, ETC.
RESILIENT TILE
* PLASTER, SAND & CEMENT
ACOUSTIC TILE
CARPET & PAD
ARCHITECTURAL TERRA COTTA
VENEER
BLOCK PARTITION

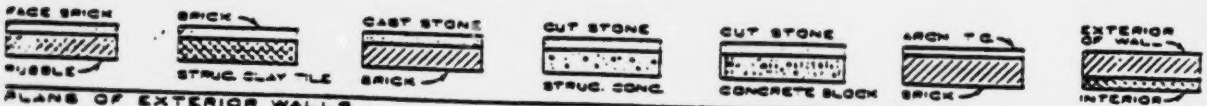
PLAN AND SECTION INDICATIONS


GLASS
ASHLAR STONE
* RUBBLE STONE
SQUARED STONE
RUNNING BOND MASONRY
STACK BOND MASONRY
SHEET METAL
CONCRETE PLASTER
SHINGLES SIDING
BRICK
CERAMIC TILE

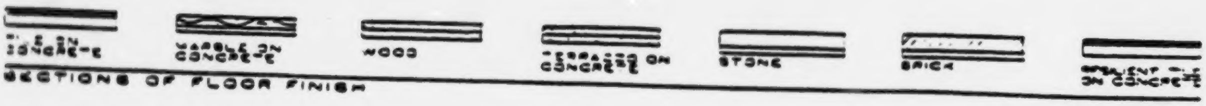
* SYMBOLS MARKED * APPROVED AS AMERICAN STANDARD, A.S.A. Y14.2-1957 BY AMERICAN NATIONAL STANDARDS ASSOCIATION

NOTE: WHEN SYMBOLS FOR MATERIALS NOT LISTED ABOVE ARE REQUIRED REFER TO A.S.A. Y14.2 1957

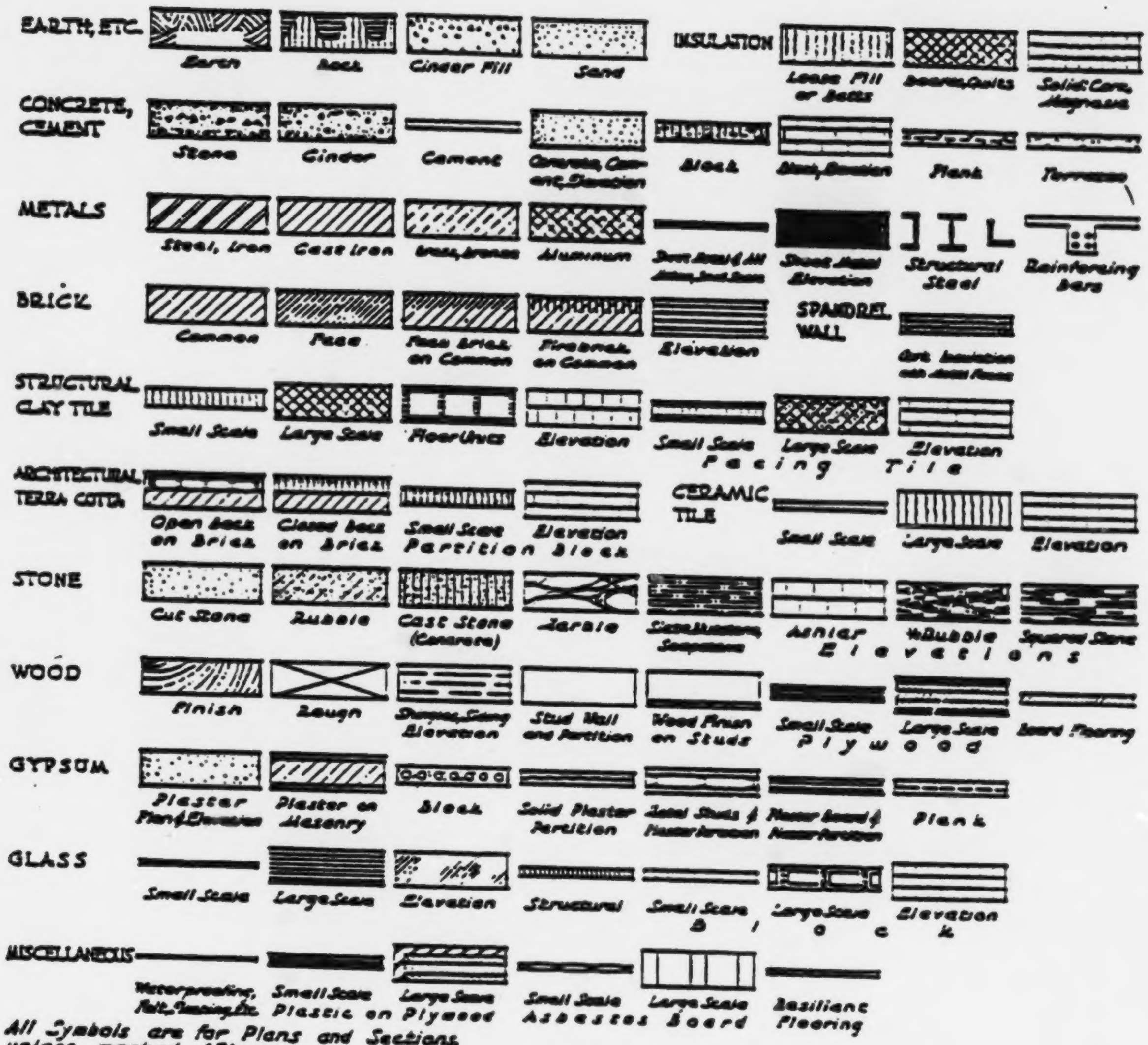
ELEVATION INDICATIONS


FACE BRICK
RUBBLE
BRICK
STRUC. CLAY TILE
CAST STONE
BRICK
CUT STONE
STRUC. CONC.
CUT STONE
CONCRETE BLOCK
ARCH. T.C.
BRICK
EXTERIOR OF WALL
INTERIOR

PLANS OF EXTERIOR WALLS

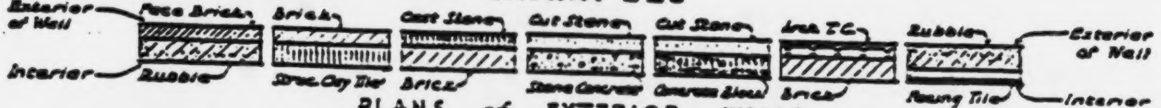

TILE ON CONCRETE
MARBLE ON CONCRETE
WOOD
TERRAZZO ON CONCRETE
STONE
BRICK
RESILIENT TILE ON CONCRETE

SECTIONS OF FLOOR FINISH

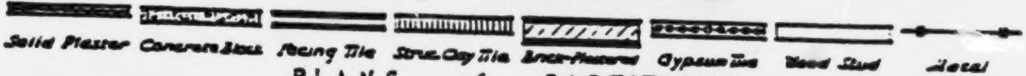

EARTH, ETC.
Earth
Rock
Cinder Fill
Sand
INSULATION
Loose Fill or Batts
Boards, Quilts
Solid Cork, Magnesia
CONCRETE, CEMENT
Stone
Cinder
Cement
Concrete, Cement, Elevation
Block
Block, Elevation
Plank
Terrazzo
METALS
Steel, Iron
Cast Iron
Brass, Bronze
Aluminum
Sheet Metal, Elevation
Structural Steel
Reinforcing bars
BRICK
Common
Face
Face Brick on Common
Firebrick on Common
Elevation
SPANDREL WALL
STRUCTURAL CLAY TILE
Small Scale
Large Scale
Floor Units
Elevation
Small Scale
Large Scale
Elevation
Facing Tile
ARCHITECTURAL TERRA COTTA
Open back on Brick
Closed back on Brick
Small Scale
Elevation
Partition Block
CERAMIC TILE
Small Scale
Large Scale
Elevation
STONE
Cut Stone
Rubble
Cast Stone (Concrete)
Marble
Ashlar
Rubble
Squared Stone
Elevations
WOOD
Finish
Rough
Shingles, Siding Elevation
Stud Wall and Partition
Wood Finish on Studs
Small Scale
Large Scale
Board Flooring
Plywood
GYPSUM
Plaster Plan & Elevation
Plaster on Masonry
Block
Solid Plaster Partition
Plank
GLASS
Small Scale
Large Scale
Elevation
Structural
Small Scale
Large Scale
Elevation
Block
MISCELLANEOUS
Waterproofing, Felt, Flashing, Etc.
Small Scale
Large Scale
Plastic on Plywood
Small Scale
Large Scale
Asbestos Board
Resiliant Flooring

All Symbols are for Plans and Sections unless marked "Elevation".

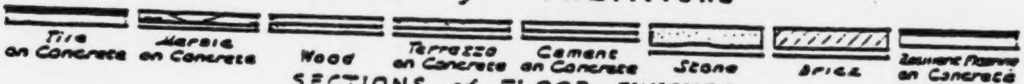
EXAMPLES


Exterior of Wall
Interior
Face Brick
Rubble
Brick
Struc. Clay Tile
Cast Stone
Brick
Cut Stone
Stone Concrete
Cut Stone
Concrete Block
Arch. T.C.
Brick
Rubble
Facing Tile
Exterior of Wall
Interior

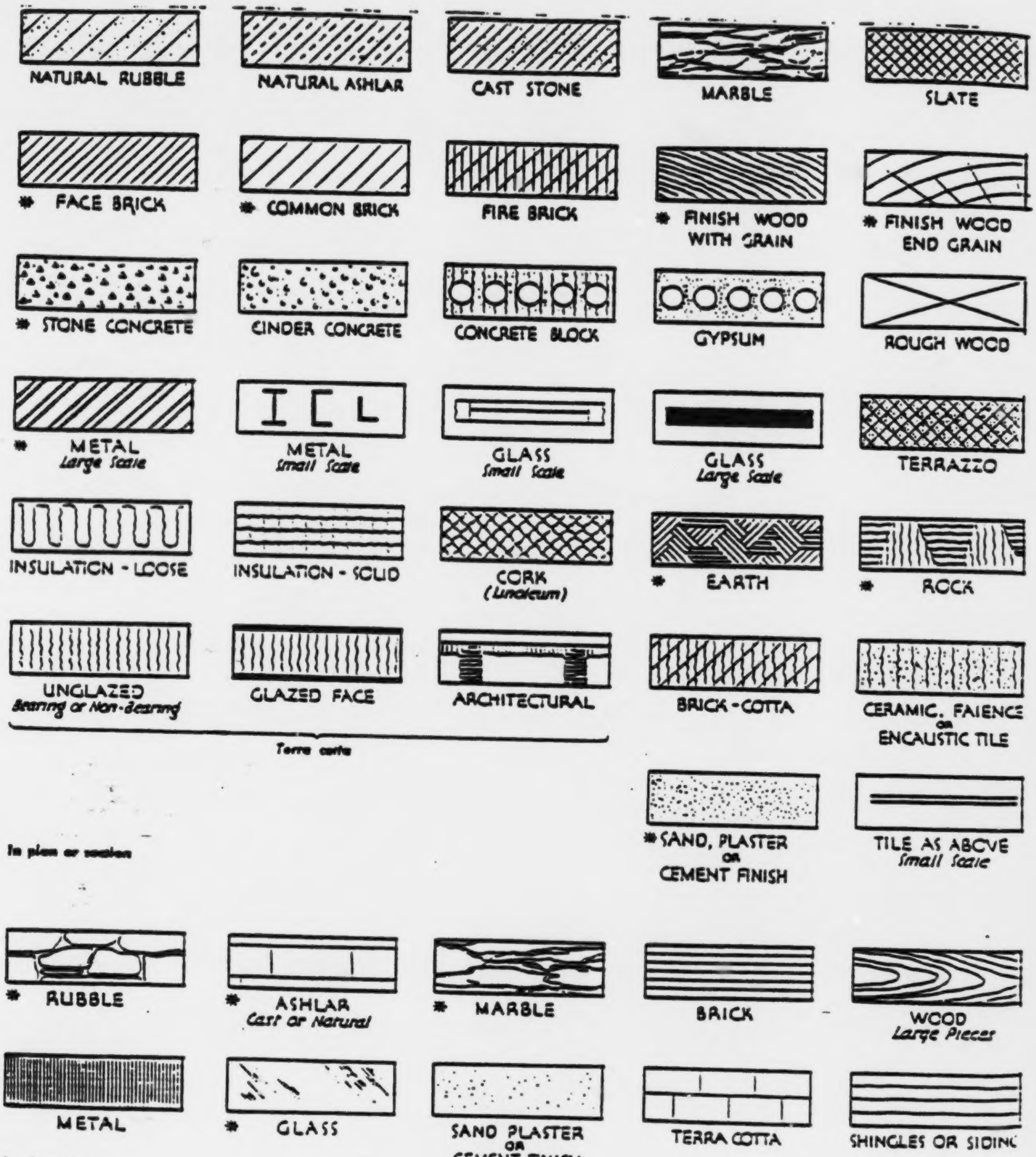
PLANS of EXTERIOR WALLS


Solid Plaster
Concrete Block
Facing Tile
Struc. Clay Tile
Brick-Plastered
Gypsum Tile
Wood Stud
Metal

PLANS of PARTITIONS


Tile on Concrete
Marble on Concrete
Wood
Terrazzo on Concrete
Cement on Concrete
Stone
Brick
Resiliant Flooring on Concrete

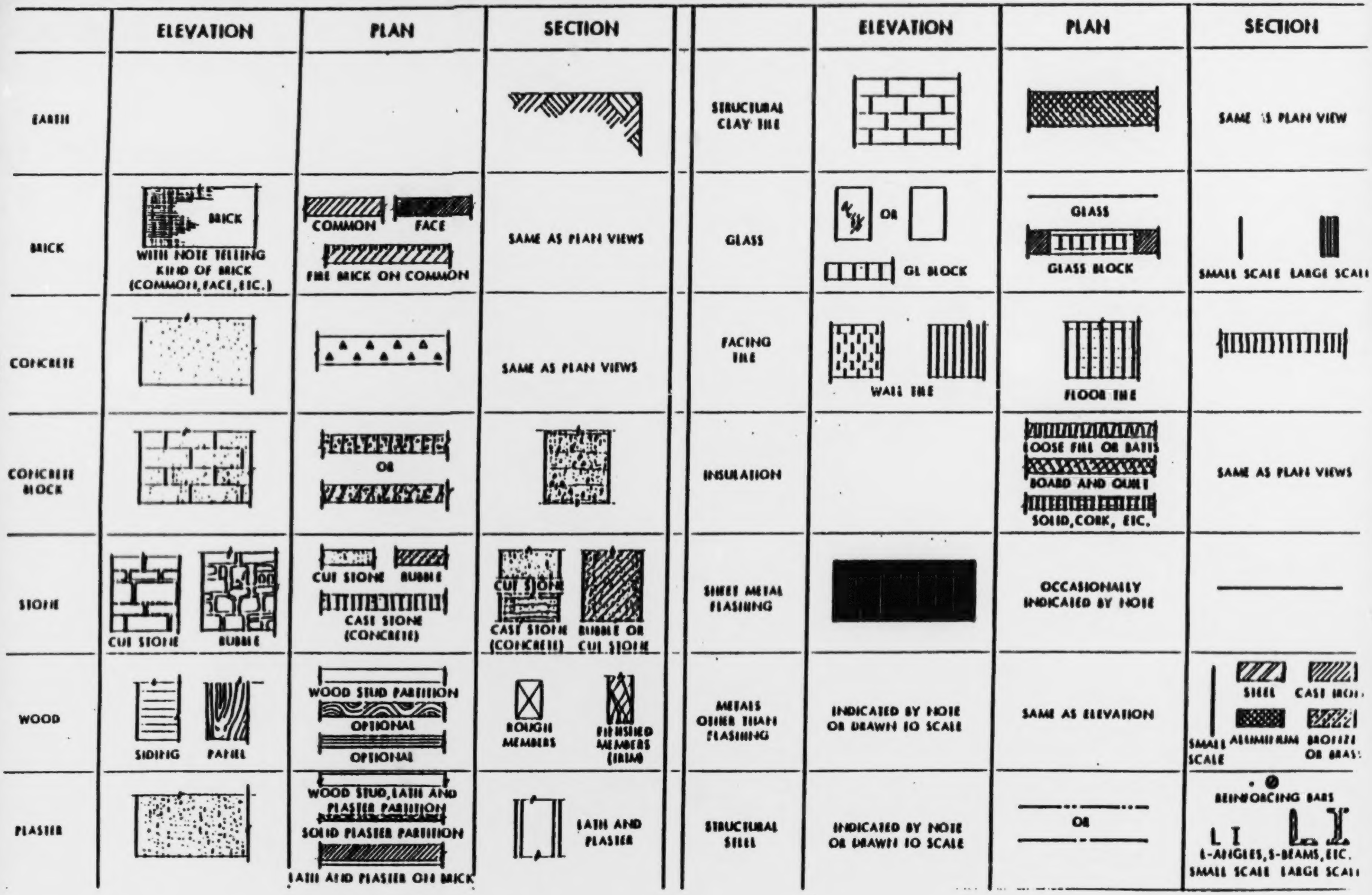
SECTIONS of FLOOR FINISHES


NATURAL RUBBLE
NATURAL ASHLAR
CAST STONE
MARBLE
SLATE
* FACE BRICK
* COMMON BRICK
FIRE BRICK
* FINISH WOOD WITH GRAIN
* FINISH WOOD END GRAIN
* STONE CONCRETE
CINDER CONCRETE
CONCRETE BLOCK
GYPSUM
ROUGH WOOD
* METAL Large Scale
METAL Small Scale
GLASS Small Scale
GLASS Large Scale
TERRAZZO
INSULATION - LOOSE
INSULATION - SOLID
CORK (Linoleum)
* EARTH
* ROCK
UNGLAZED Bearing or Non-Bearing
GLAZED FACE
ARCHITECTURAL
Terra cotta
BRICK-COTTA
CERAMIC, FAIENCE OR ENCAUSTIC TILE
*SAND, PLASTER OR CEMENT FINISH
TILE AS ABOVE Small Scale
* RUBBLE
* ASHLAR Cast or Natural
* MARBLE
BRICK
WOOD Large Pieces
METAL
* GLASS
SAND PLASTER OR CEMENT FINISH
TERRA COTTA
SHINGLES OR SIDING

In plan or section

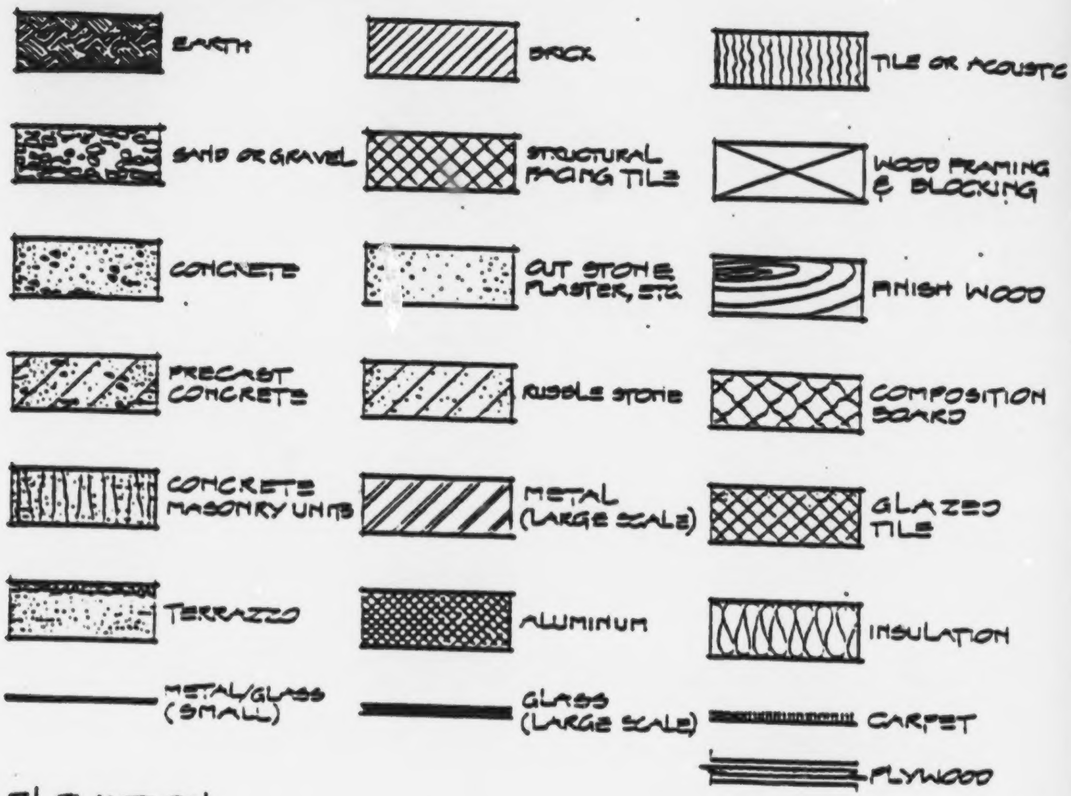
In elevation

GRAPHIC SYMBOLS

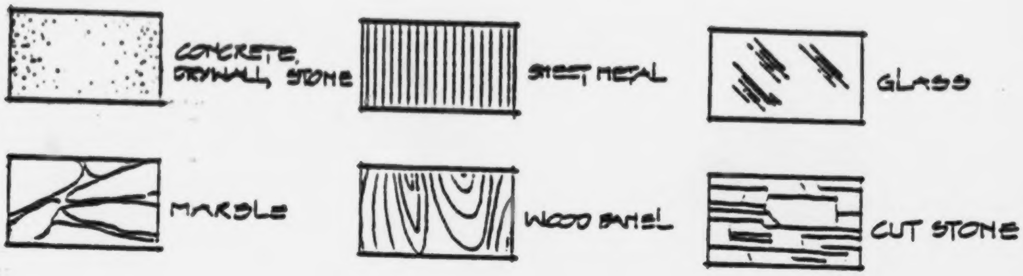


	ELEVATION	PLAN	SECTION		ELEVATION	PLAN	SECTION
EARTH				STRUCTURAL CLAY TILE			SAME AS PLAN VIEW
BRICK	BRICK WITH NOTE TELLING KIND OF BRICK (COMMON, FACE, ETC.)	COMMON FACE FIRE BRICK ON COMMON	SAME AS PLAN VIEWS	GLASS	OR GL BLOCK	GLASS GLASS BLOCK	SMALL SCALE LARGE SCAL
CONCRETE			SAME AS PLAN VIEWS	FACING TILE	WALL TILE	FLOOR TILE	
CONCRETE BLOCK		OR		INSULATION		LOOSE FILL OR BATTS BOARD AND QUILT SOLID, CORK, ETC.	SAME AS PLAN VIEWS
STONE	CUT STONE RUBBLE	CUT STONE RUBBLE CAST STONE (CONCRETE)	CUT STONE CAST STONE (CONCRETE) RUBBLE OR CUT STONE	SHEET METAL FLASHING		OCCASIONALLY INDICATED BY NOTE	
WOOD	SIDING PANEL	WOOD STUD PARTITION OPTIONAL OPTIONAL	ROUGH MEMBERS FINISHED MEMBERS (TRIM)	METALS OTHER THAN FLASHING	INDICATED BY NOTE OR DRAWN TO SCALE	SAME AS ELEVATION	STEEL CAST IRO SMALL SCALE ALUMINUM BRONZE OR BRAS
PLASTER		WOOD STUD, LATH AND PLASTER PARTITION SOLID PLASTER PARTITION LATH AND PLASTER ON BRICK	LATH AND PLASTER	STRUCTURAL STEEL	INDICATED BY NOTE OR DRAWN TO SCALE	OR	REINFORCING BARS L-ANGLES, S-BEAMS, ETC. SMALL SCALE LARGE SCAL

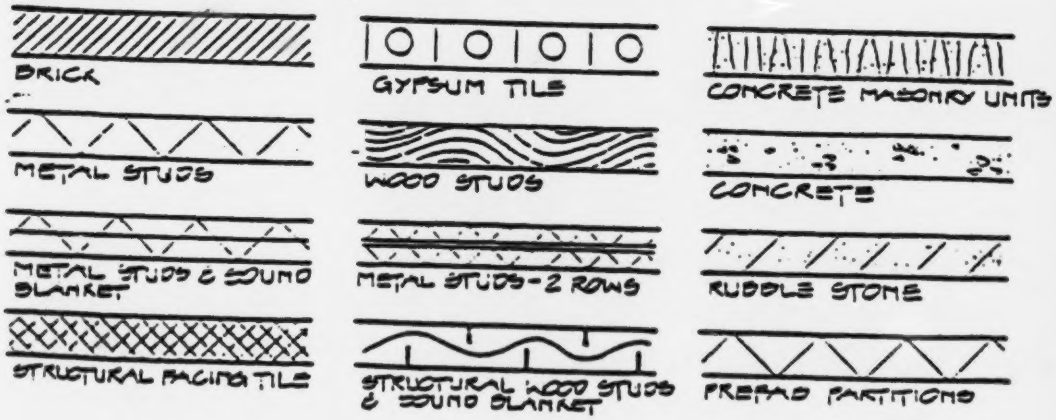
PLAN OR SECTION


EARTH
BRICK
TILE OR ACOUSTIC
SAND OR GRAVEL
STRUCTURAL FACING TILE
WOOD FRAMING & BLOCKING
CONCRETE
CUT STONE PLASTER, ETC.
FINISH WOOD
PRECAST CONCRETE
RUBBLE STONE
COMPOSITION BOARD
CONCRETE MASONRY UNITS
METAL (LARGE SCALE)
GLAZED TILE
TERRAZZO
ALUMINUM
INSULATION
METAL/GLASS (SMALL)
GLASS (LARGE SCALE)
CARPET
PLYWOOD

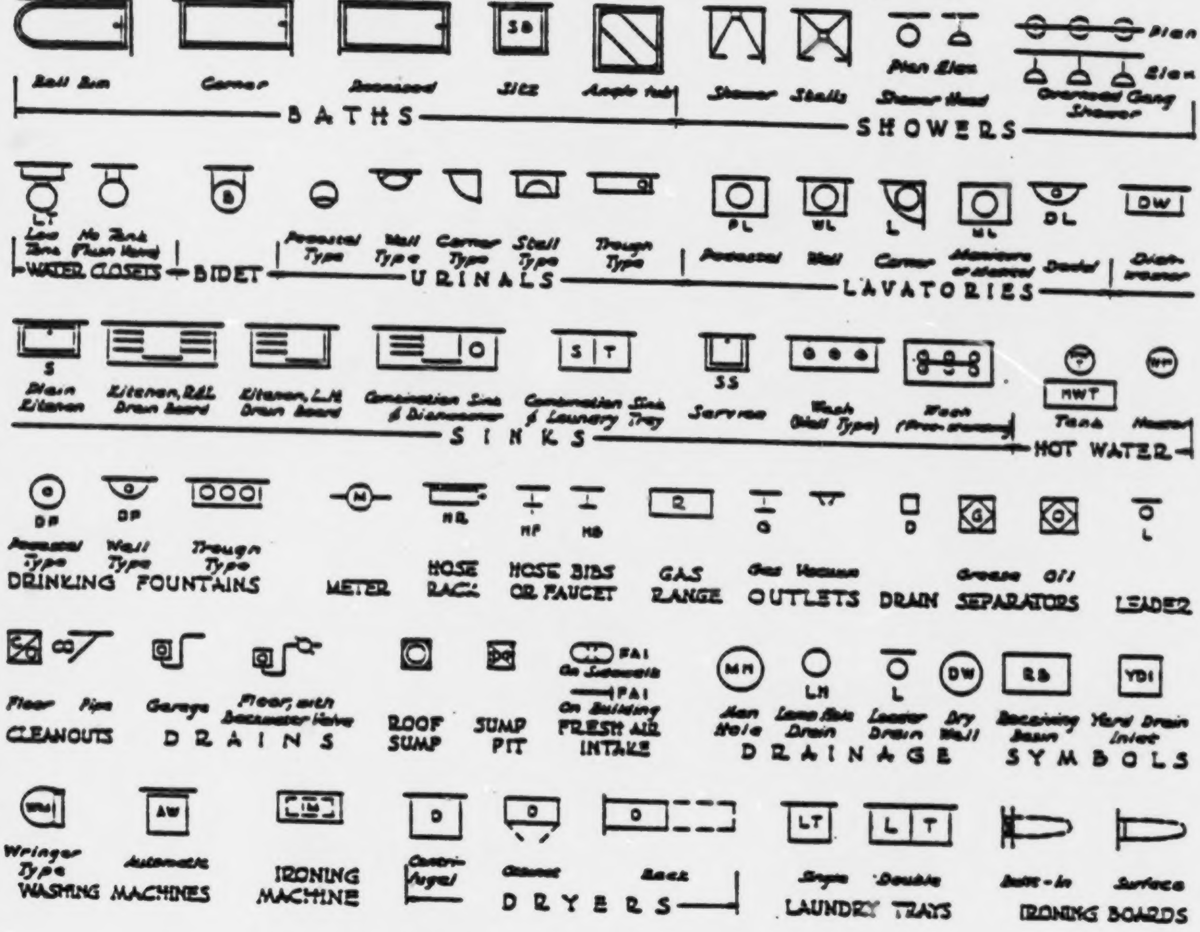
ELEVATION


CONCRETE, DRYWALL, STONE
SHEET METAL
GLASS
MARBLE
WOOD PANEL
CUT STONE

WALLS AND PARTITIONS (IN PLAN)

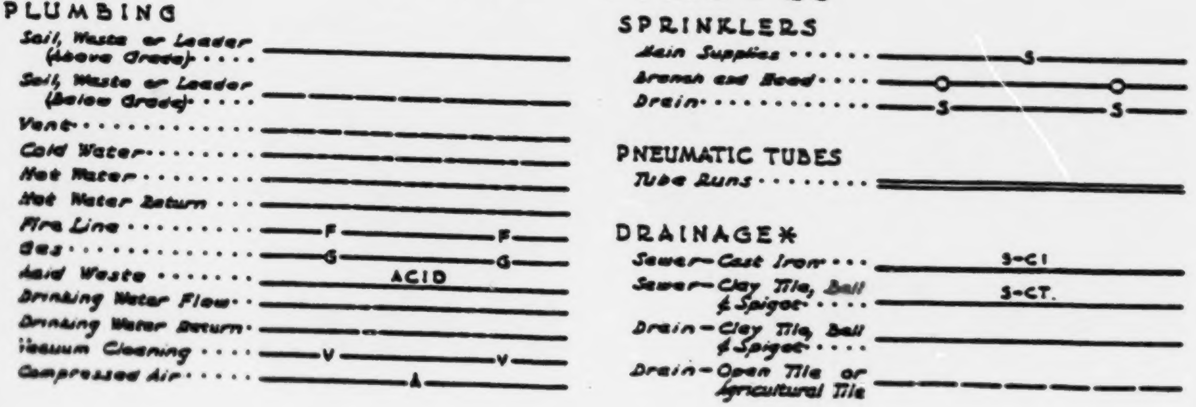

BRICK
GYPSUM TILE
CONCRETE MASONRY UNITS
METAL STUDS
WOOD STUDS
CONCRETE
METAL STUDS & SOUND BLANKET
METAL STUDS-2 ROWS
RUBBLE STONE
STRUCTURAL FACING TILE
STRUCTURAL WOOD STUDS & SOUND BLANKET
PREFAB PARTITIONS

PLUMBING FIXTURE SYMBOLS



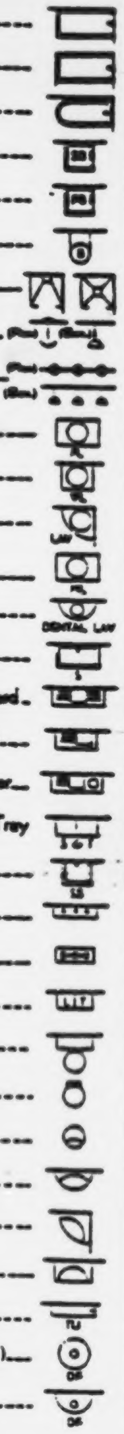
Roll Rim
Corner
Recessed
SB
Sitz
Angle tub
Shower
Stalls
Plan Elev.
Shower Head
Plan
Elev.
Overhead Gang Shower
BATHS
SHOWERS
LT
Low Tank
No Tank (Flush Valve)
WATER CLOSETS
B
BIDET
Pedestal Type
Wall Type
Corner Type
Stall Type
Trough Type
URINALS
PL
WL
L
ML
DL
DW
Pedestal
Wall
Corner
Manicure or Medical
Dental
Dishwasher
LAVATORIES
S
Plain Kitchen
Kitchen, R&L Drain Board
Kitchen, L.H. Drain Board
Combination Sink & Dishwasher
S T
Combination Sink & Laundry Tray
SS
Service
Wash (Wall Type)
Wash (Free-standing)
SINKS
HWT
Tank
WH
Heater
HOT WATER
DF
DF
Pedestal Type
Wall Type
Trough Type
DRINKING FOUNTAINS
M
METER
HR
HOSE RACK
HF
HB
HOSE BIBS OR FAUCET
R
GAS RANGE
G
V
Gas
Vacuum
OUTLETS
D
DRAIN
G
O
Grease
Oil
SEPARATORS
L
LEADER
Floor
Pipe
CLEANOUTS
Garage
Floor, with Backwater Valve
DRAINS
ROOF SUMP
SUMP PIT
FAI
On Sidewalk
FAI
On Building
FRESH AIR INTAKE
MH
Man Hole
LH
Lamp Hole Drain
L
Leader Drain
DW
Dry Well
RB
Receiving Basin
YDI
Yard Drain Inlet
DRAINAGE SYMBOLS
WM
Wringer Type
AW
Automatic
WASHING MACHINES
IM
IRONING MACHINE
D
Centrifugal
D
Cabinet
D
Rack
DRYERS
LT
Single
L T
Double
LAUNDRY TRAYS
Built-in
Surface
IRONING BOARDS

PIPING SYMBOLS



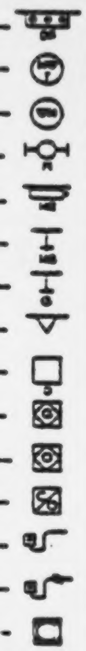
PLUMBING
Soil, Waste or Leader (Above Grade)
Soil, Waste or Leader (Below Grade)
Vent
Cold Water
Hot Water
Hot Water Return
Fire Line
F
F
Gas
G
G
Acid Waste
ACID
Drinking Water Flow
Drinking Water Return
Vacuum Cleaning
V
V
Compressed Air
A
SPRINKLERS
Main Supplies
S
Branch and Head
Drain
S
S
PNEUMATIC TUBES
Tube Runs
DRAINAGE*
Sewer—Cast Iron
S-CI
Sewer—Clay Tile, Bell & Spigot
S-CT.
Drain—Clay Tile, Bell & Spigot
Drain—Open Tile or Agricultural Tile

PLUMBING



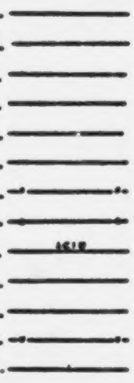
- Corner Bath
- Recessed Bath
- Roll Rim Bath
- Sitz Bath
- Foot Bath
- Bidet
- Shower Stall
- Shower Head
- Overhead Gang Shower
- Pedestal Lavatory
- Wall Lavatory
- Corner Lavatory
- Manicure Lavatory
  Medical Lavatory
- Dental Lavatory
- Plain Kitchen Sink
- Kitchen Sink, R & L Drain Board
- Kitchen Sink, L H Drain Board
- Combination Sink & Dishwasher
- Combination Sink & Laundry Tray
- Service Sink
- Wash Sink (Wall Type)
- Wash Sink
- Laundry Tray
- Water Closet (Low Tank)
- Water Closet (No Tank)
- Urinal (Pedestal Type)
- Urinal (Wall Type)
- Urinal (Corner Type)
- Urinal (Stall Type)
- Urinal (Trough Type)
- Drinking Fountain (Pedestal Type)
- Drinking Fountain (Wall Type)

PLUMBING (continued)



- Drinking Fountain (Trough Type)
- Hot Water Tank
- Water Heater
- Meter
- Hose Rack
- Hose Bibb
- Gas Outlet
- Vacuum Outlet
- Drain
- Grease Separator
- Oil Separator
- Cleanout
- Garage Drain
- Floor Drain With Backwater Valve
- Roof Sump

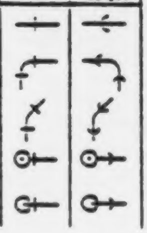
PIPING



- Soil and Waste
- Soil and Waste, Underground
- Vent
- Cold Water
- Hot Water
- Hot Water Return
- Fire Line
- Gas
- Acid Waste
- Drinking Water Supply
- Drinking Water Return
- Vacuum Cleaning
- Comprecessed Air

PIPE FITTINGS

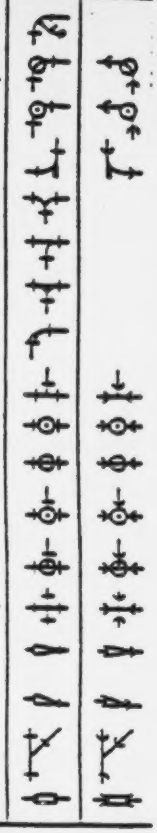
For Welded or Soldered Fittings, use joint indication shown in Diagram A — Screwed — Bell and Spigot



- Joint
- Elbow - 90 deg
- Elbow - 45 deg
- Elbow - Turned Up
- Elbow - Turned Down

PIPE FITTINGS (continued)

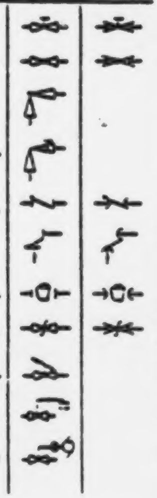
For Welded or Soldered Fittings, use joint indication shown in Diagram A — Screwed — Bell and Spigot



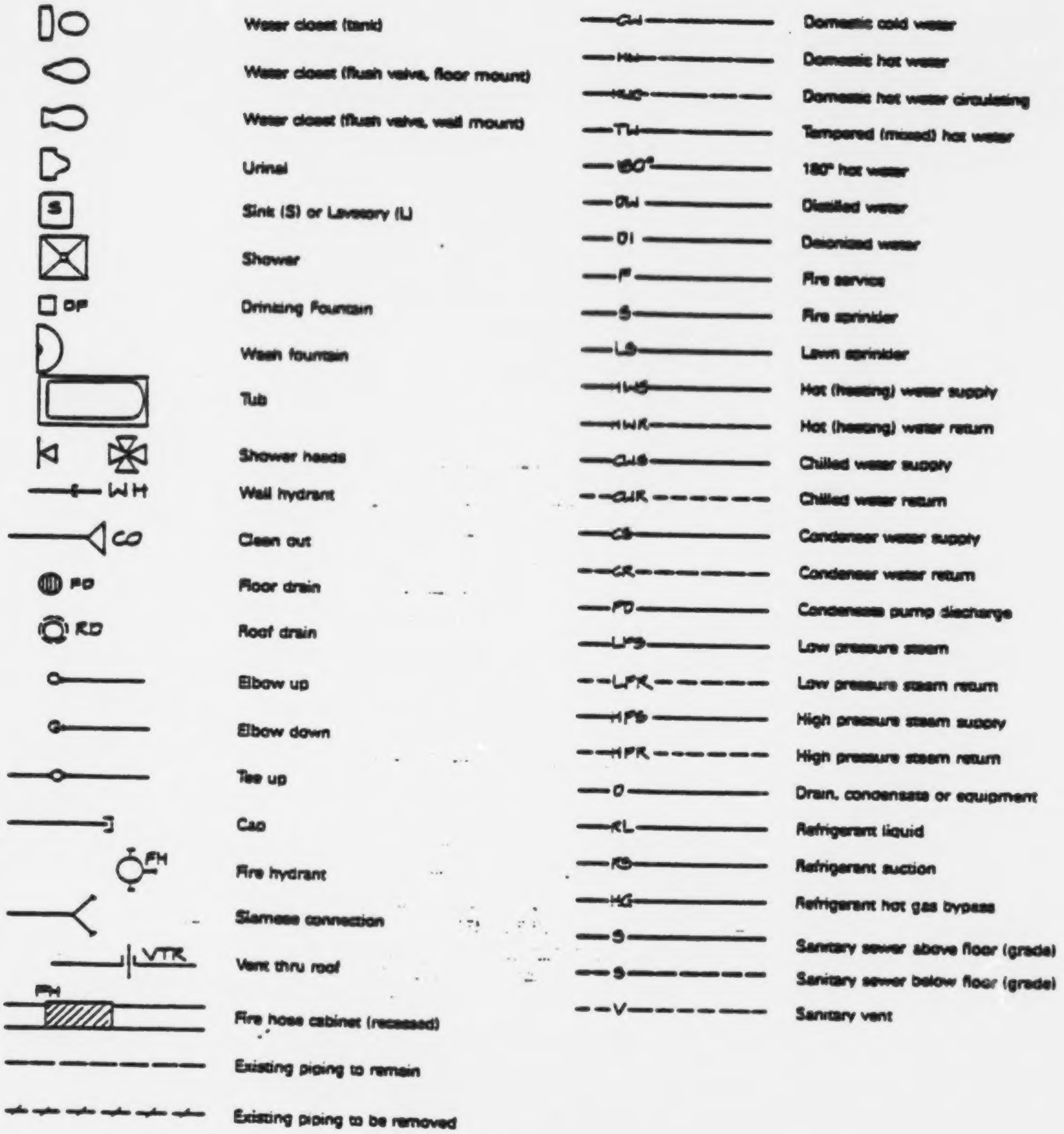
- Elbow - Long Radius
- Side Outlet Elbow - Outlet Down
- Side Outlet Elbow - Outlet Up
- Base Elbow
- Double Branch Elbow
- Single Sweep Tee
- Double Sweep Tee
- Reducing Elbow
- Tee
- Tee - Outlet Up
- Tee - Outlet Down
- Side Outlet Tee Outlet Up
- Side Outlet Tee Outlet Down
- Cross
- Reducer
- Eccentric Reducer
- Lateral
- Expansion Joint Flanged

VALVES

For Welded or Soldered Fittings, use joint indication shown in Diagram A — Screwed — Bell and Spigot

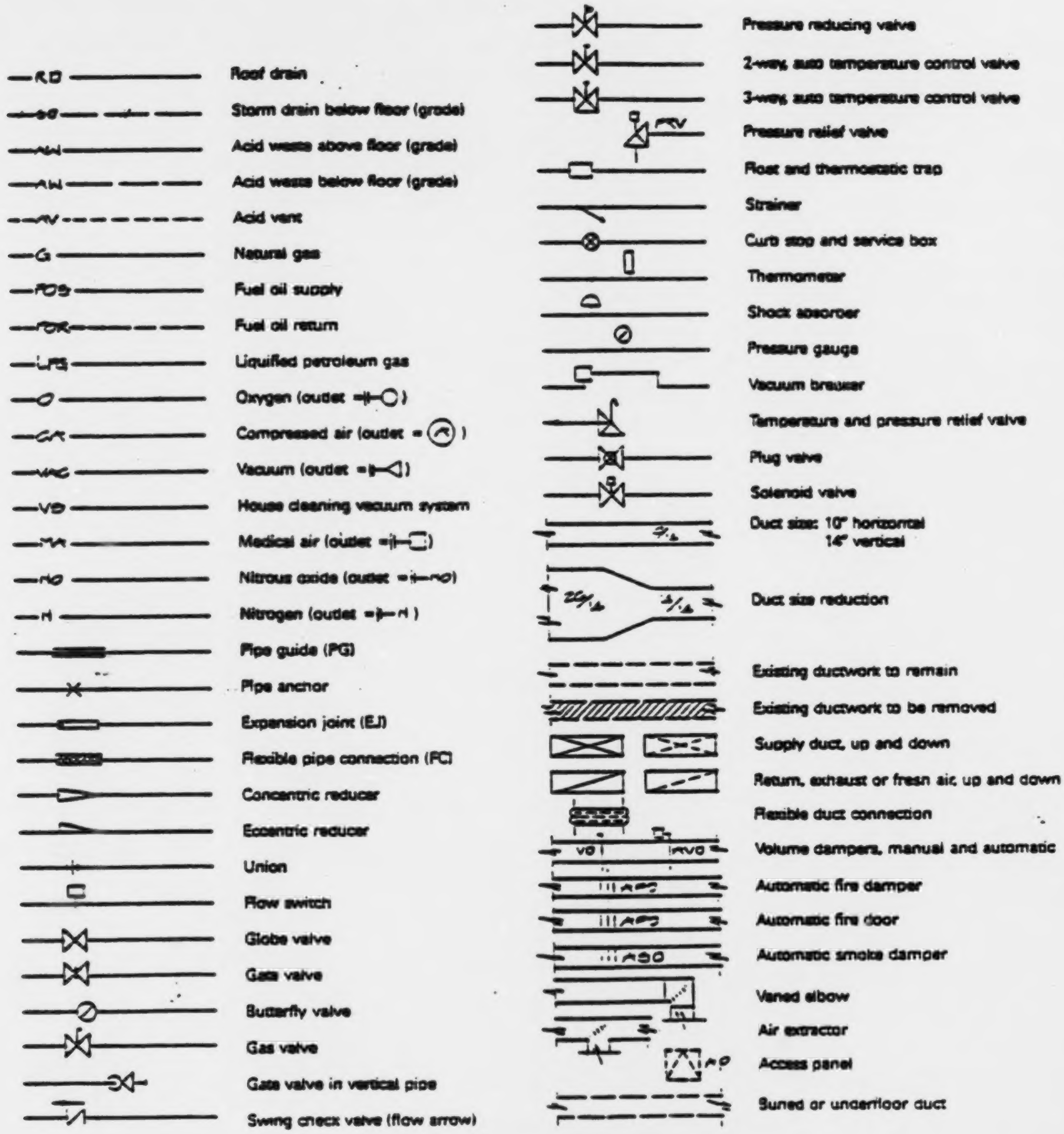


- Gate Valve
- Globe Valve
- Angle Globe Valve
- Angle Gate Valve
- Check Valve
- Angle Check Valve
- Stop Cock
- Safety Valve
- Quick Opening Valve
- Float Opening Valve
- Motor Operated Gate Valve


S
DF
WH
CO
FD
RD
FH
VTR
FH
Water closet (tank)
Water closet (flush valve, floor mount)
Water closet (flush valve, wall mount)
Urinal
Sink (S) or Lavatory (L)
Shower
Drinking Fountain
Wash fountain
Tub
Shower heads
Wall hydrant
Clean out
Floor drain
Roof drain
Elbow up
Elbow down
Tee up
Cap
Fire hydrant
Siamese connection
Vent thru roof
Fire hose cabinet (recessed)
Existing piping to remain
Existing piping to be removed
CW
HW
HWC
TW
180°
DW
DI
F
S
LS
HWS
HWR
CWS
CWR
CS
CR
PD
LPS
LPR
HPS
HPR
D
RL
RS
HG
S
S
V
Domestic cold water
Domestic hot water
Domestic hot water circulating
Tempered (mixed) hot water
180° hot water
Distilled water
Deionized water
Fire service
Fire sprinkler
Lawn sprinkler
Hot (heating) water supply
Hot (heating) water return
Chilled water supply
Chilled water return
Condenser water supply
Condenser water return
Condensate pump discharge
Low pressure steam
Low pressure steam return
High pressure steam supply
High pressure steam return
Drain, condensate or equipment
Refrigerant liquid
Refrigerant suction
Refrigerant hot gas bypass
Sanitary sewer above floor (grade)
Sanitary sewer below floor (grade)
Sanitary vent

Symbols used on architectural and plumbing drawings.

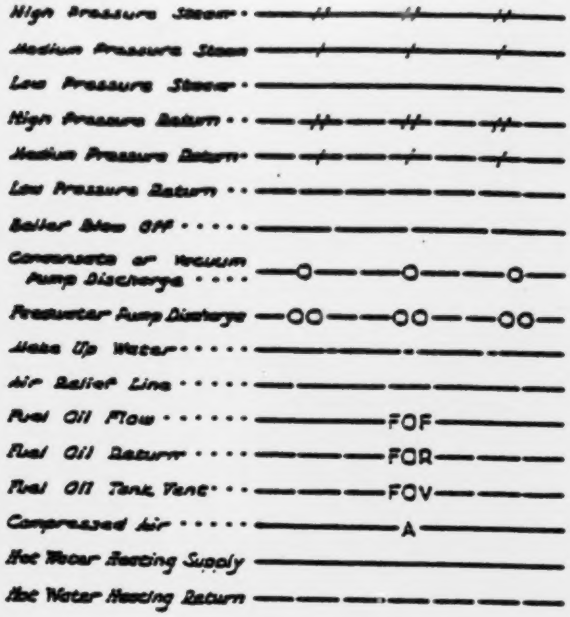
BEST COPY AVAILABLE


RD
Roof drain
SD
Storm drain below floor (grade)
AW
Acid waste above floor (grade)
AW
Acid waste below floor (grade)
AV
Acid vent
G
Natural gas
FOS
Fuel oil supply
FOR
Fuel oil return
LPG
Liquified petroleum gas
O
Oxygen (outlet =
)
CA
Compressed air (outlet =
)
VAC
Vacuum (outlet =
)
VC
House cleaning vacuum system
MA
Medical air (outlet =
)
NO
Nitrous oxide (outlet =
NO)
N
Nitrogen (outlet =
N)
Pipe guide (PG)
Pipe anchor
Expansion joint (EJ)
Flexible pipe connection (FC)
Concentric reducer
Eccentric reducer
Union
Flow switch
Globe valve
Gate valve
Butterfly valve
Gas valve
Gate valve in vertical pipe
Swing check valve (flow arrow)
Pressure reducing valve
2-way, auto temperature control valve
3-way, auto temperature control valve
PRV
Pressure relief valve
Float and thermostatic trap
Strainer
Curb stop and service box
Thermometer
Shock absorber
Pressure gauge
Vacuum breaker
Temperature and pressure relief valve
Plug valve
Solenoid valve
Duct size: 10" horizontal
14" vertical
Duct size reduction
Existing ductwork to remain
Existing ductwork to be removed
Supply duct, up and down
Return, exhaust or fresh air, up and down
Flexible duct connection
VD
AVD
Volume dampers, manual and automatic
AFD
Automatic fire damper
AFD
Automatic fire door
ASD
Automatic smoke damper
Vaned elbow
Air extractor
AP
Access panel
Buried or underfloor duct

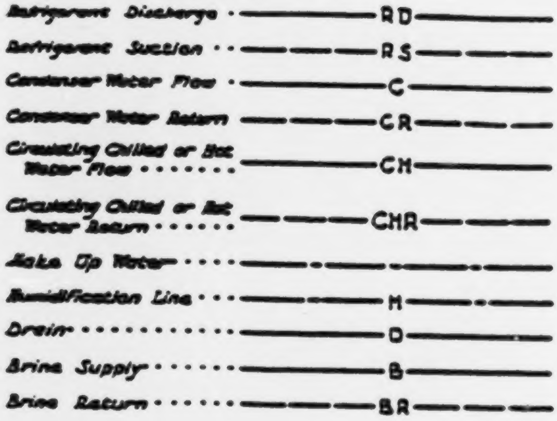
Symbols used on plumbing and mechanical drawings.

PIPING SYMBOLS

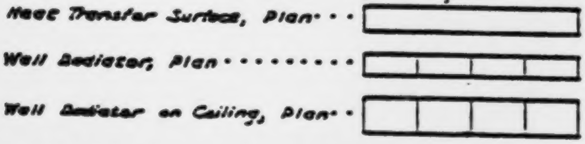
HEATING


High Pressure Steam
Medium Pressure Steam
Low Pressure Steam
High Pressure Return
Medium Pressure Return
Low Pressure Return
Boiler Blow Off
Condensate or Vacuum Pump Discharge
Feedwater Pump Discharge
Make Up Water
Air Relief Line
Fuel Oil Flow
FOF
Fuel Oil Return
FOR
Fuel Oil Tank Vent
FOV
Compressed Air
A
Hot Water Heating Supply
Hot Water Heating Return

AIR CONDITIONING

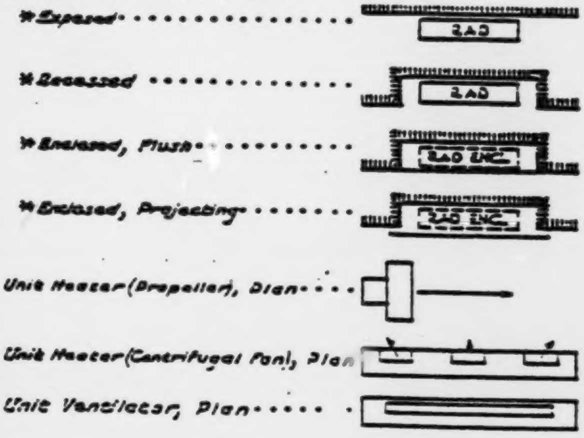

Refrigerant Discharge
RD
Refrigerant Suction
RS
Condenser Water Flow
C
Condenser Water Return
CR
Circulating Chilled or Hot Water Flow
CH
Circulating Chilled or Hot Water Return
CHR
Make Up Water
Humidification Line
H
Drain
D
Brine Supply
B
Brine Return
BR

HEATING & VENTILATING SYMBOLS

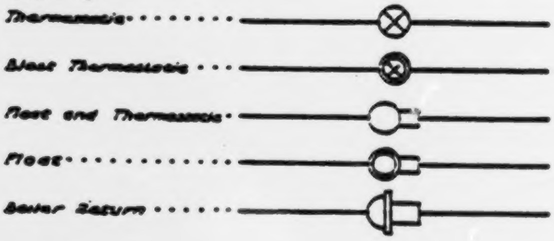

Heat Transfer Surface, Plan
Wall Radiator, Plan
Wall Radiator on Ceiling, Plan

RADIATORS & CONVECTORS, PLANS — *for Architectural Drawings.*

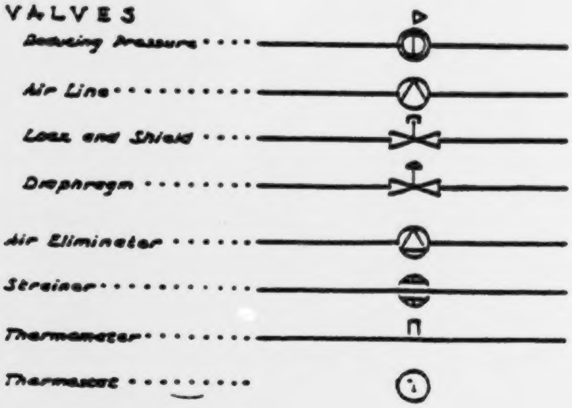
For Radiator — If Convector is used instead of Radiator, substitute CONV. for RAD.

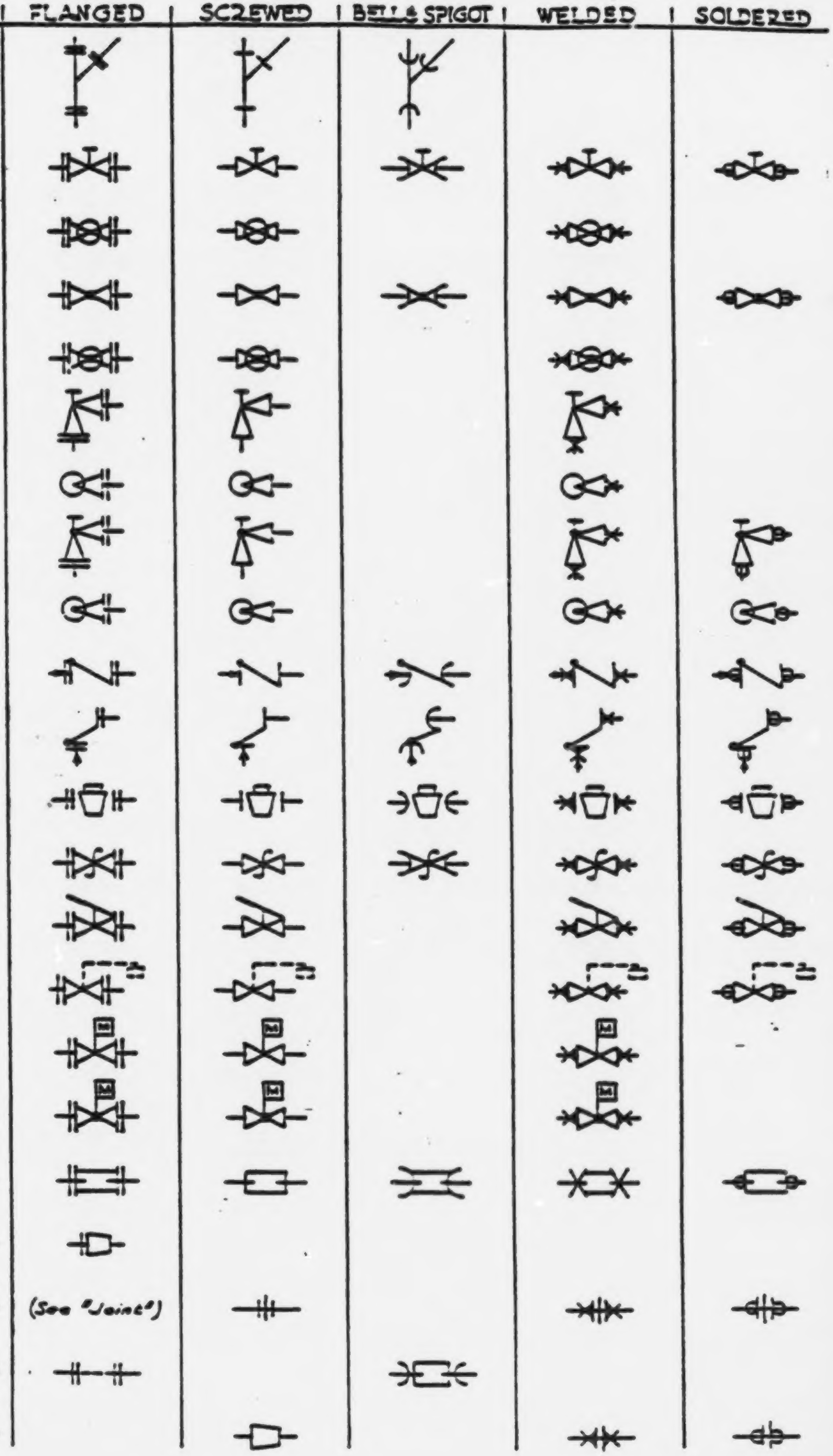

*Exposed
RAD
*Recessed
RAD
*Enclosed, Flush
RAD ENC.
*Enclosed, Projecting
RAD ENC.
Unit Heater (Propeller), Plan
Unit Heater (Centrifugal Fan), Plan
Unit Ventilator, Plan

TRAPS

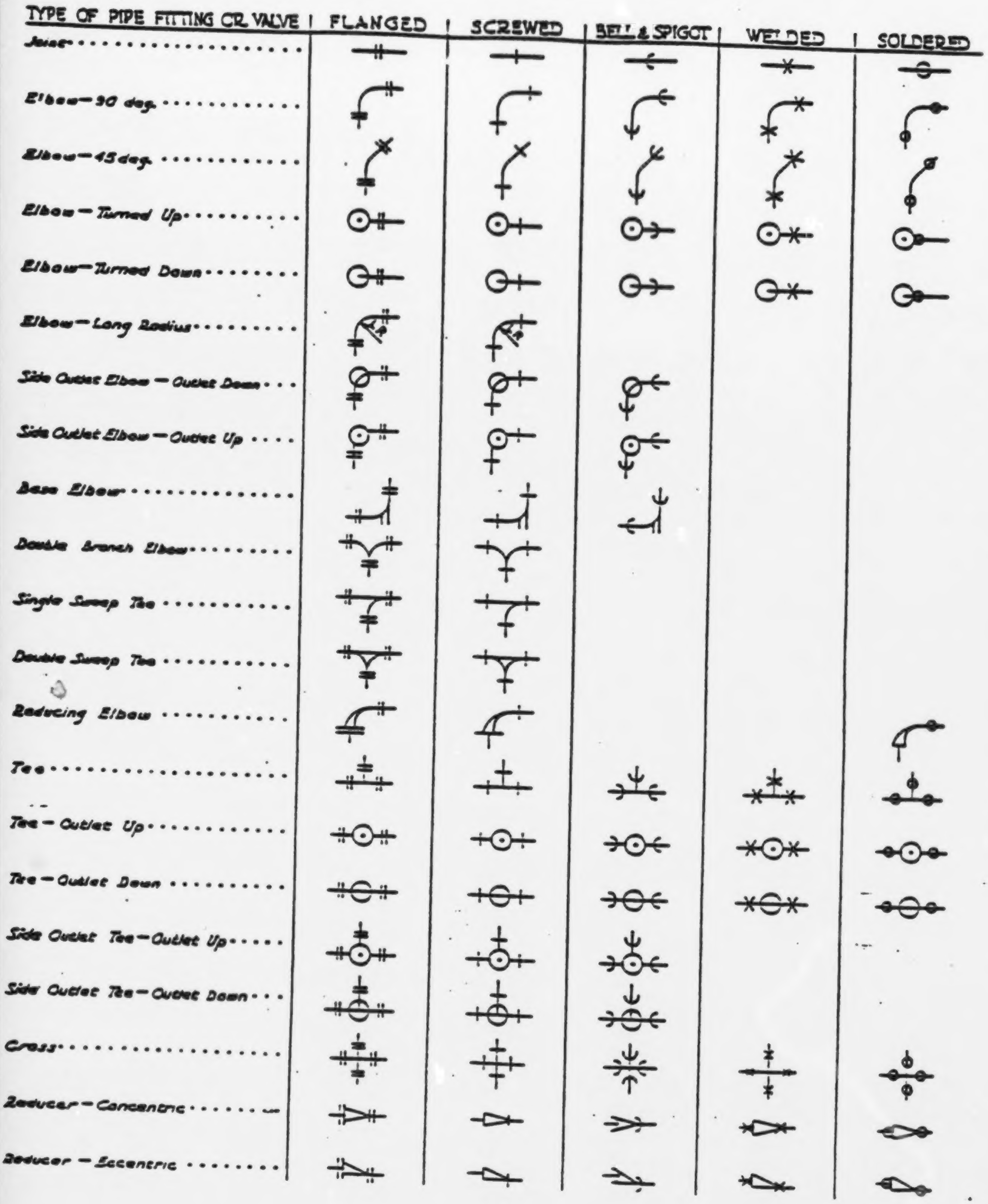

Thermostatic
Blast Thermostatic
Float and Thermostatic
Float
Boiler Return

VALVES


Reducing Pressure
Air Line
Lock and Shield
Diaphragm
Air Eliminator
Strainer
Thermometer
Thermostat



TYPE OF PIPE FITTING OR VALVE	FLANGED	SCREWED	BELL & SPIGOT	WELDED	SOLDERED
Lateral					
Gate Valve, Elevation					
Gate Valve, Plan					
Globe Valve, Elevation					
Globe Valve, Plan					
Angle Gate Valve, Elevation					
Angle Gate Valve, Plan					
Angle Globe Valve, Elevation					
Angle Globe Valve, Plan					
Check Valve					
Angle Check Valve					
Stop Cock					
Safety Valve					
Quick Opening Valve					
Float Operating Valve					
Motor Operated Gate Valve					
Motor Operated Globe Valve					
Expansion Joint Flanged					
Reducing Flange					
Union	(See "Joint")				
Sleeve					
Bushing					


TYPE OF PIPE FITTING OR VALVE
FLANGED
SCREWED
BELL & SPIGOT
WELDED
SOLDERED
Joint
Elbow—90 deg.
Elbow—45 deg.
Elbow—Turned Up
Elbow—Turned Down
Elbow—Long Radius
Side Outlet Elbow—Outlet Down
Side Outlet Elbow—Outlet Up
Base Elbow
Double Branch Elbow
Single Sweep Tee
Double Sweep Tee
Reducing Elbow
Tee
Tee—Outlet Up
Tee—Outlet Down
Side Outlet Tee—Outlet Up
Side Outlet Tee—Outlet Down
Cross
Reducer—Concentric
Reducer—Eccentric

430

AIR CONDITIONING

Brine Return	— — —BR— — —
Brine Supply	———B———
Circulating Chilled or Hot-Water Flow	———CH———
Circulating Chilled or Hot-Water Return	— — —CHR— — —
Condenser Water Flow	———C———
Condenser Water Return	— — —CR— — —
Drain	———D———
Humidification Line	—·——·——·——
Make-Up Water	—·——·——·——
Refrigerant Discharge	———RD———
Refrigerant Liquid	———RL———
Refrigerant Suction	— — —RS— — —

HEATING

Air-Relief Line	—— — —— —
Boiler Blow Off	—— —— —— ——
Compressed Air	———A———
Condensate or Vacuum Pump Discharge	—o— —o— —o—
Feedwater Pump Discharge	—oo— —oo— —oo—
Fuel-Oil Flow	———FOF———
Fuel-Oil Return	— — —FOR— — —
Fuel-Oil Tank Vent	— — —FOV— — —
High-Pressure Return	— — — — — — —
High-Pressure Steam	——————
Hot-Water Heating Return	— — — — — —
Hot-Water Heating Supply	——————
Low-Pressure Return	— — — — — — — —
Low-Pressure Steam	——————
Make-Up Water	—·— —·— —·—
Medium-Pressure Return	— — — — — — —
Medium-Pressure Steam	——————

PLUMBING

Acid Waste	——ACID——
Cold Water	—·—·—·—·—
Compressed Air	———A———
Drinking-Water Flow	—— —— ·——
Drinking-Water Return	——· —— ·——
Fire Line	——F————F——
Gas	——G————G——
Hot Water	——·————·——
Hot-Water Return	——·——·——·——
Soil, Waste or Leader (Above Grade)	——————
Soil, Waste or Leader (Below Grade)	— — — — — — —
Vacuum Cleaning	—V————V——
Vent	- - - - - - - - - -

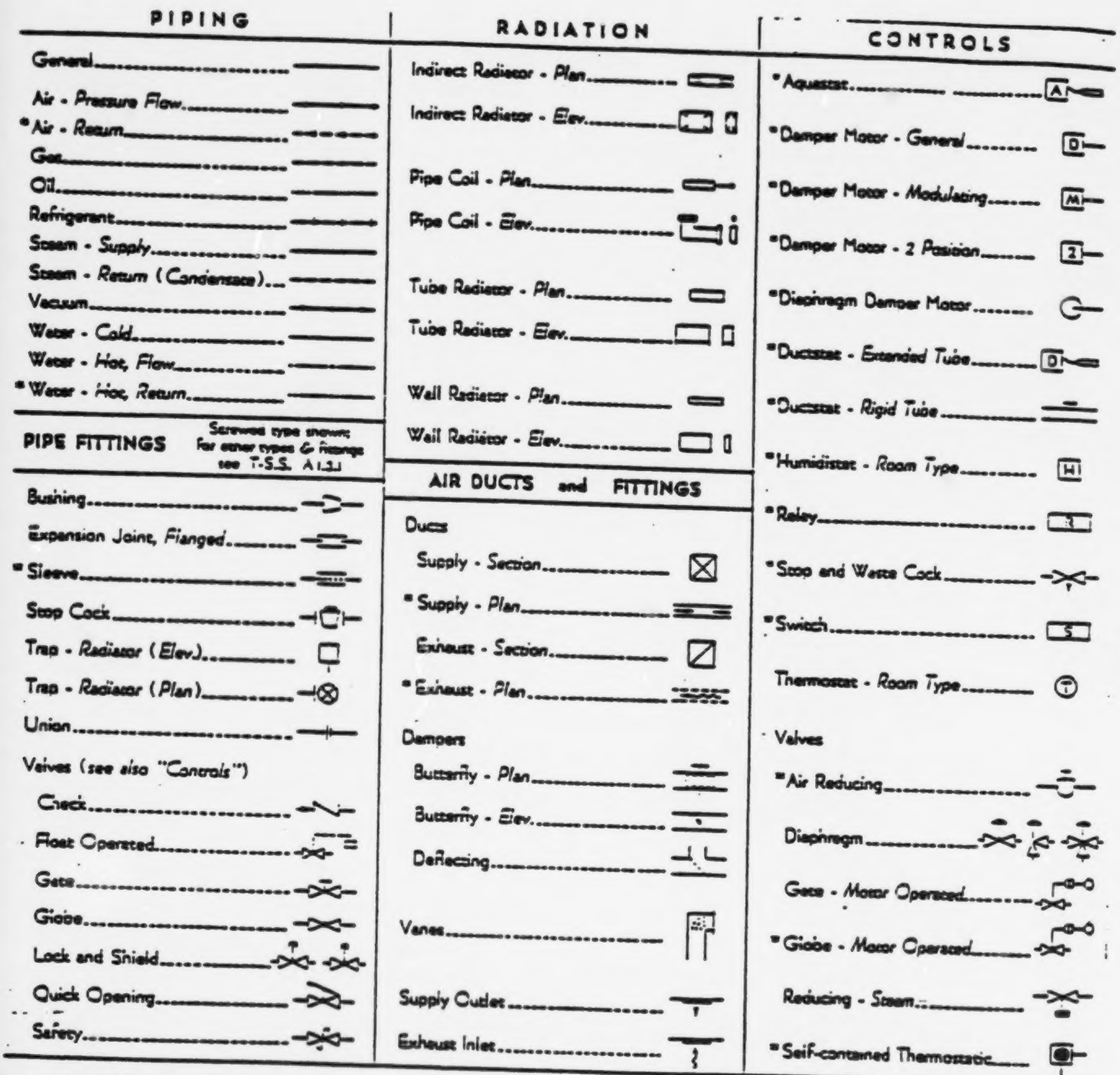
PNEUMATIC TUBES

Tube Runs	══════

SPRINKLERS

Branch and Head	——o————o——
Drain	——S— — — —S——
Main Supplies	———S———

431



PIPING

- General
- Air - *Pressure Flow*
- *Air - *Return*
- Gas
- Oil
- Refrigerant
- Steam - *Supply*
- Steam - *Return* (*Condensate*)
- Vacuum
- Water - *Cold*
- Water - *Hot, Flow*
- *Water - *Hot, Return*

PIPE FITTINGS

Screwed type shown; for other types & fittings see T-S.S. A1.31

- Bushing
- Expansion Joint, *Flanged*
- *Sleeve
- Stop Cock
- Trap - *Radiator* (*Elev.*)
- Trap - *Radiator* (*Plan*)
- Union
- Valves (*see also "Controls"*)
  - Check
  - Float Operated
  - Gate
  - Globe
  - Lock and Shield
  - Quick Opening
  - Safety

RADIATION

- Indirect Radiator - *Plan*
- Indirect Radiator - *Elev.*
- Pipe Coil - *Plan*
- Pipe Coil - *Elev.*
- Tube Radiator - *Plan*
- Tube Radiator - *Elev.*
- Wall Radiator - *Plan*
- Wall Radiator - *Elev.*

AIR DUCTS and FITTINGS

Ducts

- Supply - *Section*
- *Supply - *Plan*
- Exhaust - *Section*
- *Exhaust - *Plan*

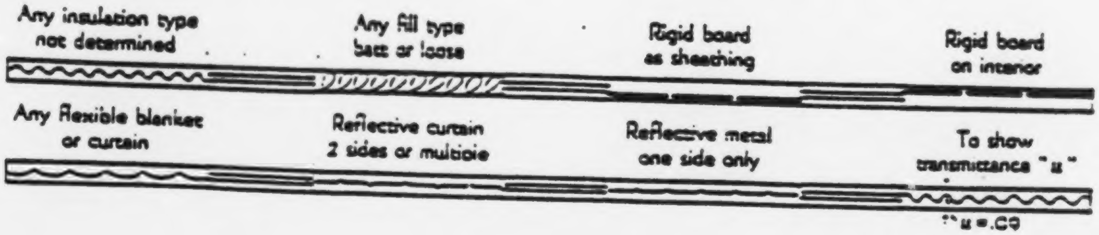
Dampers

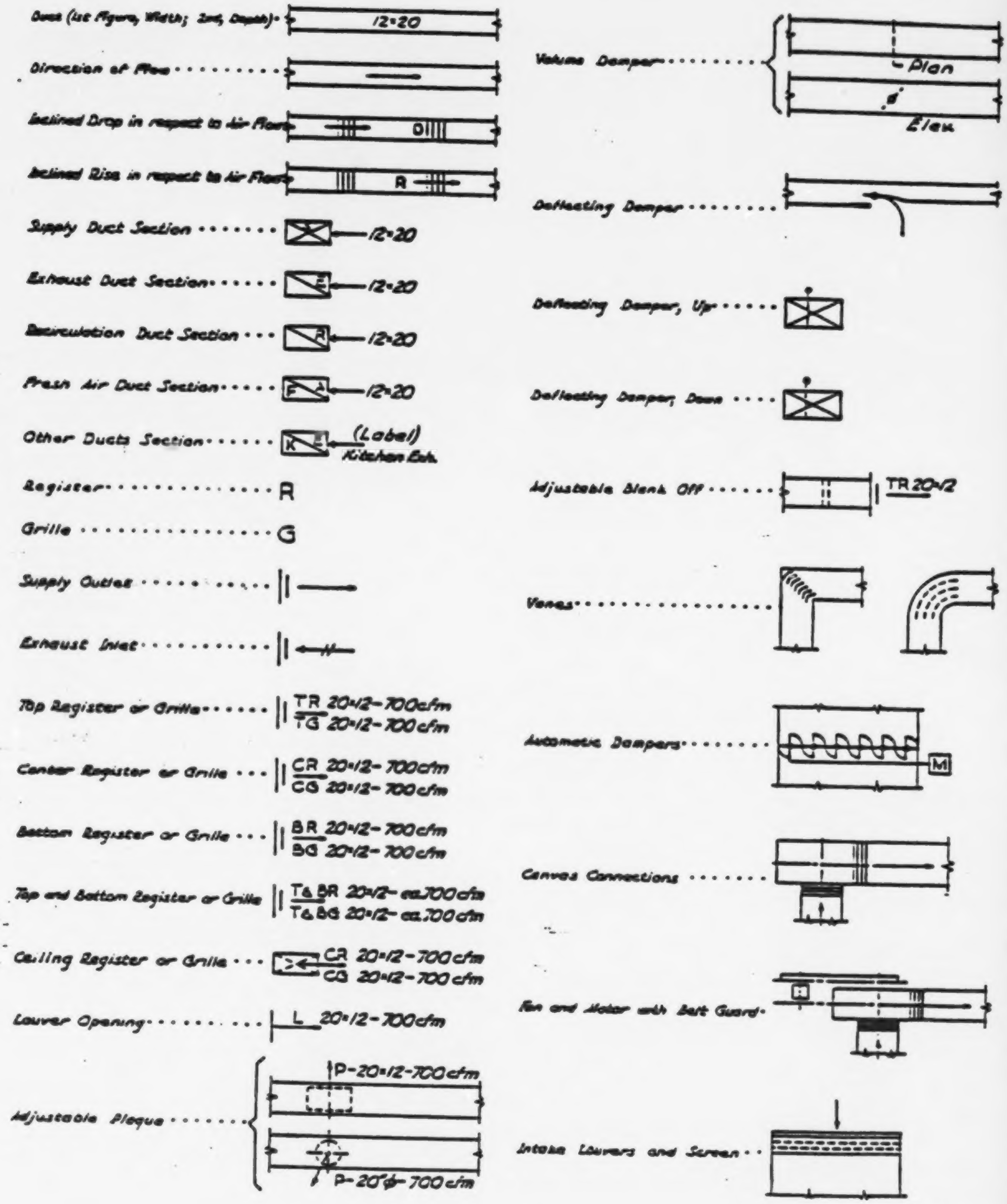
- Butterfly - *Plan*
- Butterfly - *Elev.*
- Deflecting
- Vanes
- Supply Outlet
- Exhaust Inlet

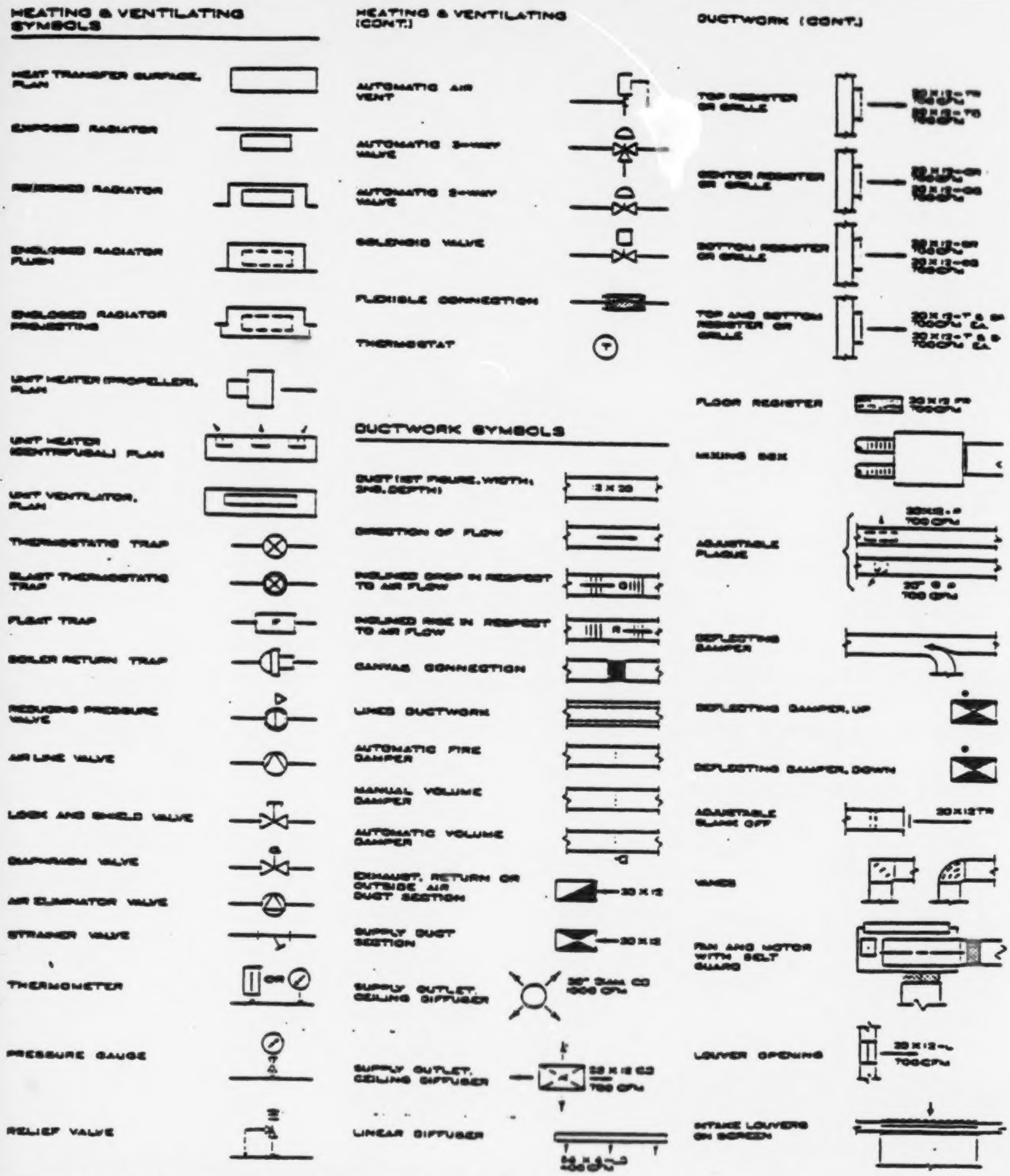
CONTROLS

- *Aquastat
- *Damper Motor - *General*
- *Damper Motor - *Modulating*
- *Damper Motor - *2 Position*
- *Diaphragm Damper Motor
- *Ductstat - *Extended Tube*
- *Ductstat - *Rigid Tube*
- *Humidistat - *Room Type*
- *Relay
- *Stop and Waste Cock
- *Switch
- Thermostat - *Room Type*
- Valves
  - *Air Reducing
  - Diaphragm
  - Gate - *Motor Operated*
  - *Globe - *Motor Operated*
  - Reducing - *Steam*
  - *Self-contained Thermostatic

INSULATION SYMBOLS

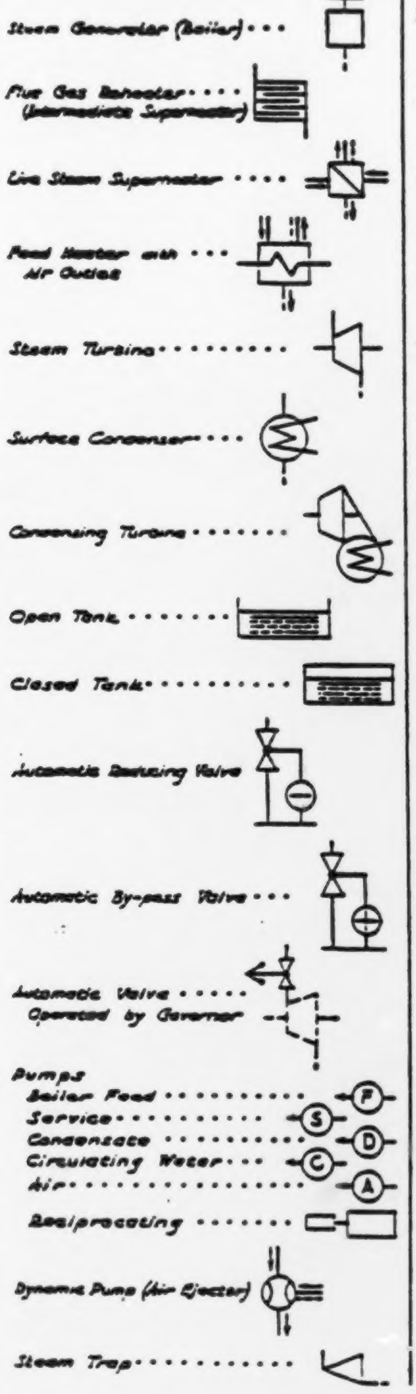

Any insulation type not determined
Any fill type batt or loose
Rigid board as sheathing
Rigid board on interior
Any flexible blanket or curtain
Reflective curtain 2 sides or multiple
Reflective metal one side only
To show transmittance "u"
"u = .09


Duct (1st Figure, Width; 2nd, Depth)
12×20
Direction of Flow
Inclined Drop in respect to Air Flow
D
Inclined Rise in respect to Air Flow
R
Supply Duct Section
12×20
Exhaust Duct Section
E
12×20
Recirculation Duct Section
R
12×20
Fresh Air Duct Section
F
A
12×20
Other Ducts Section
K
E
(Label)
Kitchen Exh.
Register
R
Grille
G
Supply Outlet
Exhaust Inlet
Top Register or Grille
TR 20×12–700cfm
TG 20×12–700cfm
Center Register or Grille
CR 20×12–700cfm
CG 20×12–700cfm
Bottom Register or Grille
BR 20×12–700cfm
BG 20×12–700cfm
Top and Bottom Register or Grille
T&BR 20×12–ea.700cfm
T&BG 20×12–ea.700cfm
Ceiling Register or Grille
CR 20×12–700cfm
CG 20×12–700cfm
Louver Opening
L 20×12–700cfm
Adjustable Plaque
P–20×12–700cfm
P–20"ϕ–700cfm
Volume Damper
Plan
Elev.
Deflecting Damper
Deflecting Damper, Up
Deflecting Damper, Down
Adjustable Blank Off
TR 20×12
Vanes
Automatic Dampers
M
Canvas Connections
Fan and Motor with Belt Guard
Intake Louvers and Screen

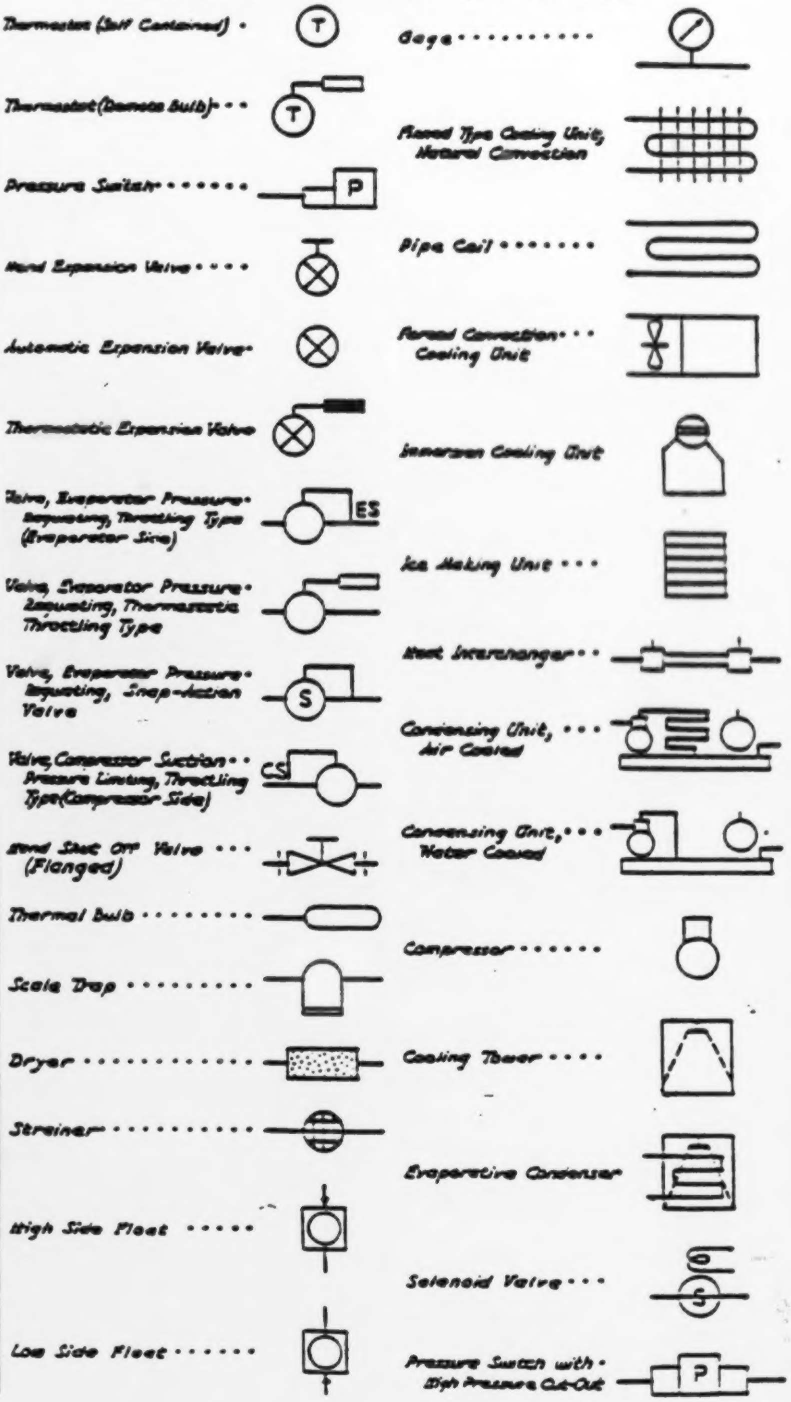

HEATING & VENTILATING SYMBOLS
HEAT TRANSFER SURFACE, PLAN
EXPOSED RADIATOR
RECESSED RADIATOR
ENCLOSED RADIATOR FLUSH
ENCLOSED RADIATOR PROJECTING
UNIT HEATER (PROPELLER), PLAN
UNIT HEATER (CENTRIFUGAL) PLAN
UNIT VENTILATOR, PLAN
THERMOSTATIC TRAP
BLAST THERMOSTATIC TRAP
FLOAT TRAP
F
BOILER RETURN TRAP
REDUCING PRESSURE VALVE
AIR LINE VALVE
LOCK AND SHIELD VALVE
DIAPHRAGM VALVE
AIR ELIMINATOR VALVE
STRAINER VALVE
THERMOMETER
OR
PRESSURE GAUGE
RELIEF VALVE
HEATING & VENTILATING (CONT.)
AUTOMATIC AIR VENT
AUTOMATIC 3-WAY VALVE
AUTOMATIC 2-WAY VALVE
SOLENOID VALVE
FLEXIBLE CONNECTION
THERMOSTAT
T
DUCTWORK SYMBOLS
DUCT (1ST FIGURE, WIDTH; 2ND, DEPTH)
12 X 20
DIRECTION OF FLOW
INCLINED DROP IN RESPECT TO AIR FLOW
D
INCLINED RISE IN RESPECT TO AIR FLOW
R
CANVAS CONNECTION
LINED DUCTWORK
AUTOMATIC FIRE DAMPER
MANUAL VOLUME DAMPER
AUTOMATIC VOLUME DAMPER
EXHAUST, RETURN OR OUTSIDE AIR DUCT SECTION
20 X 12
SUPPLY DUCT SECTION
20 X 12
SUPPLY OUTLET, CEILING DIFFUSER
20" DIAM CD 1000 CFM
SUPPLY OUTLET, CEILING DIFFUSER
20 X 12 CD 700 CFM
LINEAR DIFFUSER
24 X 4-LD 400 CFM
DUCTWORK (CONT.)
TOP REGISTER OR GRILLE
20 X 12-TR 700CFM
20 X 12-TG 700CFM
CENTER REGISTER OR GRILLE
20 X 12-CR 700CFM
20 X 12-CG 700CFM
BOTTOM REGISTER OR GRILLE
20 X 12-BR 700CFM
20 X 12-BG 700CFM
TOP AND BOTTOM REGISTER OR GRILLE
20 X 12-T & BR 700CFM EA.
20 X 12-T & B 700CFM EA.
FLOOR REGISTER
20 X 12 FR 700CFM
MIXING BOX
ADJUSTABLE PLAQUE
20X12-P 700 CFM
20" Ø P 700 CFM
DEFLECTING DAMPER
DEFLECTING DAMPER, UP
DEFLECTING DAMPER, DOWN
ADJUSTABLE BLANK OFF
20 X 12TR
VANES
FAN AND MOTOR WITH BELT GUARD
LOUVER OPENING
20 X 12-L 700CFM
INTAKE LOUVERS ON SCREEN

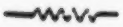
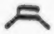
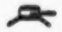
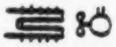
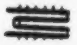
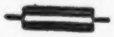
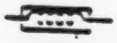
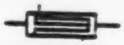
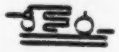
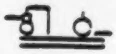
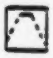
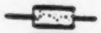
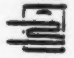
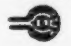
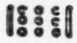
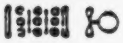
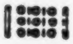
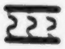
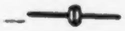
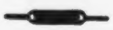
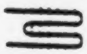
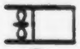
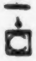
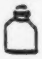
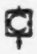
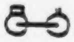
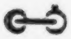
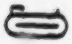
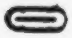
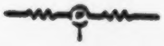
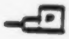
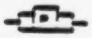
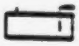
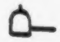
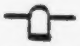
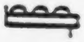
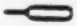
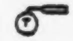
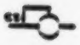
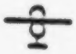
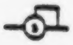
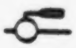
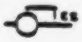
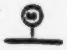
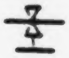
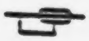
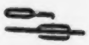
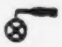
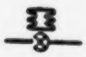
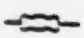
Amer Hasanin, P. E.; Ayres, Cohen and Hayakawa Consulting Engineers Los Angeles-San Francisco, California

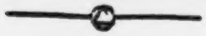
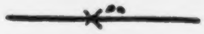
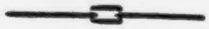
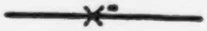
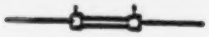
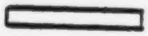
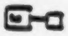
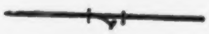
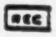
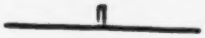
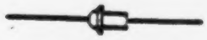
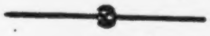
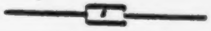
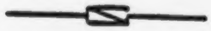
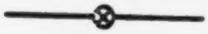
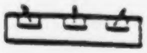
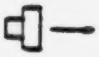
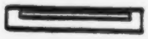
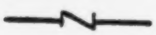
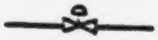
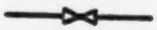
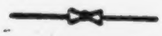
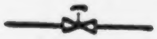
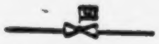
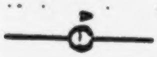
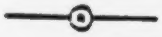
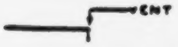
HEAT-POWER APPARATUS SYMBOLS

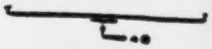
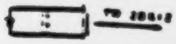
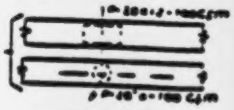
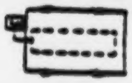
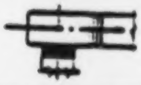
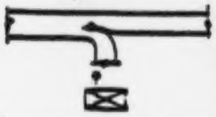
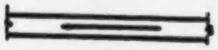
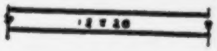
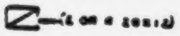
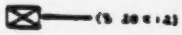
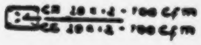
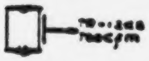
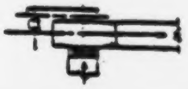
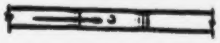
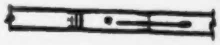
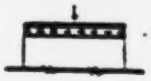
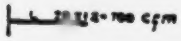
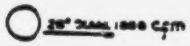
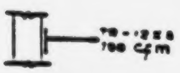
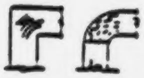
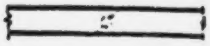

Steam Generator (Boiler)
Flue Gas Reheater (Intermediate Superheater)
Live Steam Superheater
Feed Heater with Air Outlet
Steam Turbine
Surface Condenser
Condensing Turbine
Open Tank
Closed Tank
Automatic Reducing Valve
Automatic By-pass Valve
Automatic Valve Operated by Governor
Pumps
Boiler Feed
Service
Condensate
Circulating Water
Air
F
S
D
C
A
Reciprocating
Dynamic Pump (Air Ejector)
Steam Trap

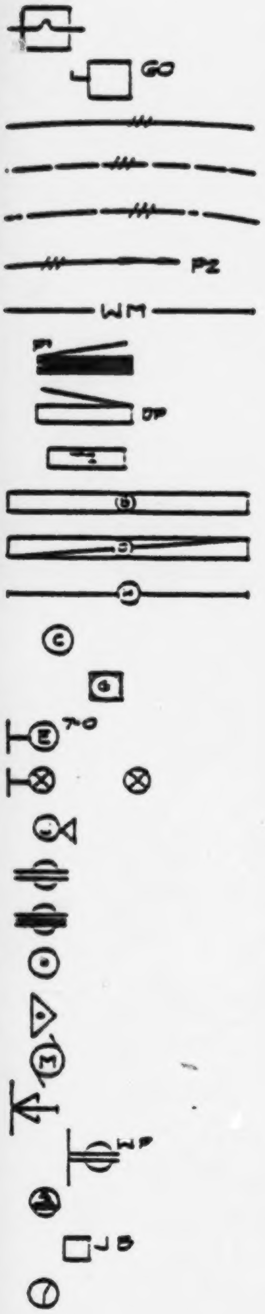
REFRIGERATING SYMBOLS


Thermostat (Self Contained)
T
Thermostat (Remote Bulb)
T
Pressure Switch
P
Hand Expansion Valve
Automatic Expansion Valve
Thermostatic Expansion Valve
Valve, Evaporator Pressure Regulating, Throttling Type (Evaporator Side)
ES
Valve, Evaporator Pressure Regulating, Thermostatic Throttling Type
Valve, Evaporator Pressure Regulating, Snap-Action Valve
S
Valve, Compressor Suction Pressure Limiting, Throttling Type (Compressor Side)
CS
Hand Shut Off Valve (Flanged)
Thermal Bulb
Scale Trap
Dryer
Strainer
High Side Float
Low Side Float
Gage
Finned Type Cooling Unit, Natural Convection
Pipe Coil
Forced Convection Cooling Unit
Immersion Cooling Unit
Ice Making Unit
Heat Interchanger
Condensing Unit, Air Cooled
Condensing Unit, Water Cooled
Compressor
Cooling Tower
Evaporative Condenser
Solenoid Valve
S
Pressure Switch with High Pressure Cut-Out
P

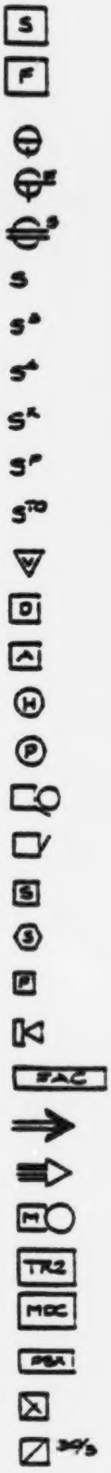
Capillary Tube	
Compressor	
Compressor, Enclosed, Crankcase, Rotary, Belted	
Compressor, Open Crankcase, Reciprocating, Belted	
Compressor, Open Crankcase, Reciprocating, Direct Drive	
Condenser, Air Cooled, Finned, Forced Air	
Condenser, Air Cooled, Finned, Static	
Condenser, Water Cooled, Concentric Tube in a Tube	
Condenser, Water Cooled, Shell and Coil	
Condenser, Water Cooled, Shell and Tube	
Condensing Unit, Air Cooled	
Condensing Unit, Water Cooled	
Cooling Tower	
Dryer	
Evaporative Condenser	
Evaporator, Circular, Ceiling Type, Finned	
Evaporator, Manifolded, Bare Tube, Gravity Air	
Evaporator, Manifolded, Finned, Forced Air	
Evaporator, Manifolded, Finned, Gravity Air	
Evaporator, Plate Coils, Headered or Manifold	
Filter, Line	
Filter & Strainer, Line	
Finned Type Cooling Unit, Natural Convection	
Forced Convection Cooling Unit	
Gauge	
High Side Float	
Immersion Cooling Unit	
Low Side Float	
Motor-Compressor, Enclosed Crankcase, Reciprocating, Direct Connected	
Motor-Compressor, Enclosed Crankcase, Rotary, Direct Connected	
Motor-Compressor, Sealed Crankcase, Reciprocating	
Motor-Compressor, Sealed Crankcase, Rotary	
Pressurestat	
Pressure Switch	
Pressure Switch With High Pressure Cut-Out	
Receiver, Horizontal	
Receiver, Vertical	
Scale Trap	
Spray Pond	
Thermal Bulb	
Thermostat (Remote bulb)	
Valve, Automatic Expansion	
Valve, Compressor Suction Pressure Limiting, Throttling Type (Compressor Side)	
Valve, Constant Pressure, Suction	
Valve, Evaporator Pressure Regulating, Snap Action	
Valve, Evaporator Pressure Regulating, Thermostatic Throttling Type	
Valve, Evaporator Pressure Regulating, Throttling Type (Evaporator side)	
Valve, Hand Expansion	
Valve, Magnetic Stop	
Valve, Snap Action	
Valve, Suction Vapor Regulating	
Valve, Thermo Suction	
Valve, Thermostatic Expansion	
Valve, Water	
Vibration Absorber, Line	

Air Eliminator	
Anchor	
Expansion Joint	
Hanger or Support	
Heat Exchanger	
Heat Transfer Surface, Plan (Indicate type such as convector)	
Pump (Indicate type such as vacuum)	
Strainer	
Tank (Designate type)	
Thermometer	
Thermostat	
Trap, Boiler Return	
Trap, Blast Thermostatic	
Trap, Float	
Trap, Float and Thermostatic	
Trap, Thermostatic	
Unit Heater (Centrifugal fan), Plan	
Unit Heater (Propeller), Plan	
Unit Ventilator, Plan	
Valve, Check	
Valve, Diaphragm	
Valve, Gate	
Valve, Globe	
Valve, Lock and Shield	
Valve, Motor Operated	
Valve, Reducing Pressure	
Valve, Relief (Either pressure or vacuum)	
Vent Point	

Access Door	
Adjustable Blank Off	
Adjustable Plaque	
Automatic Dampers	
Canvas Connections	
Deflecting Damper	
Direction of Flow	
Duct (1st figure, side shown; 2nd side not shown)	
Duct Section (Exhaust or Return)	
Duct Section (Supply)	
Exhaust Inlet Ceiling (Indicate type)	
Exhaust Inlet Wall (Indicate type)	
Fan and Motor with Belt Guard	
Inclined Drop in Respect to Air Flow	
Inclined Rise in Respect to Air Flow	
Intake Louvers on Screen	
Louver Opening	
Supply Outlet Ceiling (Indicate type)	
Supply Outlet Wall (Indicate type)	
Vanes	
Volume Damper	

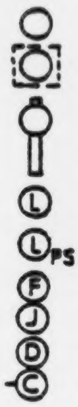


- Circuit breaker
- Safety switch or motor disconnect 60 A
- Conduit concealed in wall or ceiling, diagonals indicate wires
- Conduit exposed
- Conduit, underfloor/underground
- Home runs to panel 2. Diagonals indicate wires: arrows indicate circuits
- Wiremold
- Panelboard (light & receptacles)
- Distribution panel (DP) or Switchboard (SB)
- Telephone terminal cabinet No. 2
- Fluorescent fixture, surface
- Fluorescent fixture, recessed
- Fluorescent strip fixture
- Incandescent fixture, ceiling surface
- Incandescent fixture, ceiling, recessed
- Incandescent fixture, wall mounted, height
- Exit fixture, wall and ceiling
- Spot or flood fixture
- Duplex convenience outlet
- Three-wire, appliance outlet
- Floor convenience outlet
- Telephone outlet, floor
- Motor
- Television outlet
- Duplex weatherproof receptacle
- Special purpose outlet, noted
- Junction box
- Clock



- Smoke detector
- Firestat
- Pneumatic thermostat
- Electric thermostat
- Combination switch/outlet
- Switch, single pole
- Switch, three-way
- Switch, four-way
- Switch, key operated
- Switch with pilot lamp
- Switch, thermal overload
- Volume control
- Dimmer
- Amplifier
- Humidistat
- Photo electric cell
- Bell
- Buzzer
- Wall speaker
- Ceiling speaker
- Break-glass station
- Fire alarm horn
- Fire alarm control
- Telephone entrance
- Power entrance
- Meter
- Transformer (at apx size)
- Main distribution center (at apx size)
- Private board exchange
- Magnetic starter
- Contactor, 30 A/3 pole

General Outlets



Lighting Outlet

Ceiling Lighting Outlet for recessed fixture (Outline shows shape of fixture.)

Continuous Wireway for Fluorescent Lighting on ceiling, in coves, cornices, etc. (Extend rectangle to show length of installation.)

Lighting Outlet with Lamp Holder

Lighting Outlet with Lamp Holder and Pull Switch

Fan Outlet

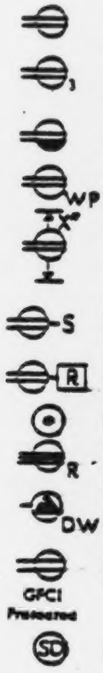
Junction Box

Drop-Cord Equipped Outlet

Clock Outlet

To indicate wall installation of above outlets, place circle near wall and connect with line as shown for clock outlet.

Convenience Outlets



Duplex Convenience Outlet

Triplex Convenience Outlet (Substitute other numbers for other variations in number of plug positions.)

Duplex Convenience Outlet — Split Wired

Weatherproof Convenience Outlet

Multi-Outlet Assembly (Extend arrows to limits of installation. Use appropriate symbol to indicate type of outlet. Also indicate spacing of outlets as X inches.)

Combination Switch and Convenience Outlet

Combination Radio and Convenience Outlet

Floor Outlet

Range Outlet

Special-Purpose Outlet. Use subscript letters to indicate function. DW-Dishwasher, CD-Clothes Dryer, etc.

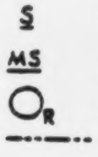
Protected by Ground Fault Circuit Interrupter

Smoke Detector

Switch Outlets

S	Single-Pole Switch
S_3	Three-Way Switch
S_4	Four-Way Switch
S_D	Automatic Door Switch
S_P	Switch and Pilot Light
S_{WP}	Weatherproof Switch
S_2	Double-Pole Switch

Low-Voltage and Remote-Control Switching Systems



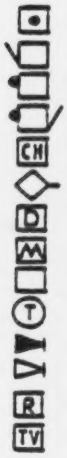
Switch for Low-Voltage Relay Systems

Master Switch for Low-Voltage Relay Systems

Relay—Equipped Lighting Outlet

Low-Voltage Relay System Wiring

Auxiliary Systems



Push Button

Buzzer

Bell

Combination Bell-Buzzer

Chime

Annunciator

Electric Door Opener

Maid's Signal Plug

Interconnection Box

Bell-Ringing Transformer

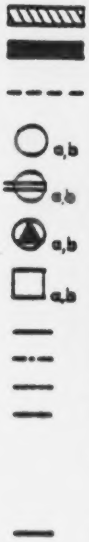
Outside Telephone

Interconnecting-Telephone

Radio Outlet

Television Outlet

Miscellaneous



Service Panel

Distribution Panel

Switch Leg Indication. Connects outlets with control points.

Special Outlets. Any standard symbol given above may be used with the addition of subscript letters to designate some special variation of standard equipment for a particular architectural plan. When so used, the variation should be explained in the Key of Symbols and, if necessary, in the specifications.

Branch Circuit; Concealed in Ceiling or Wall.

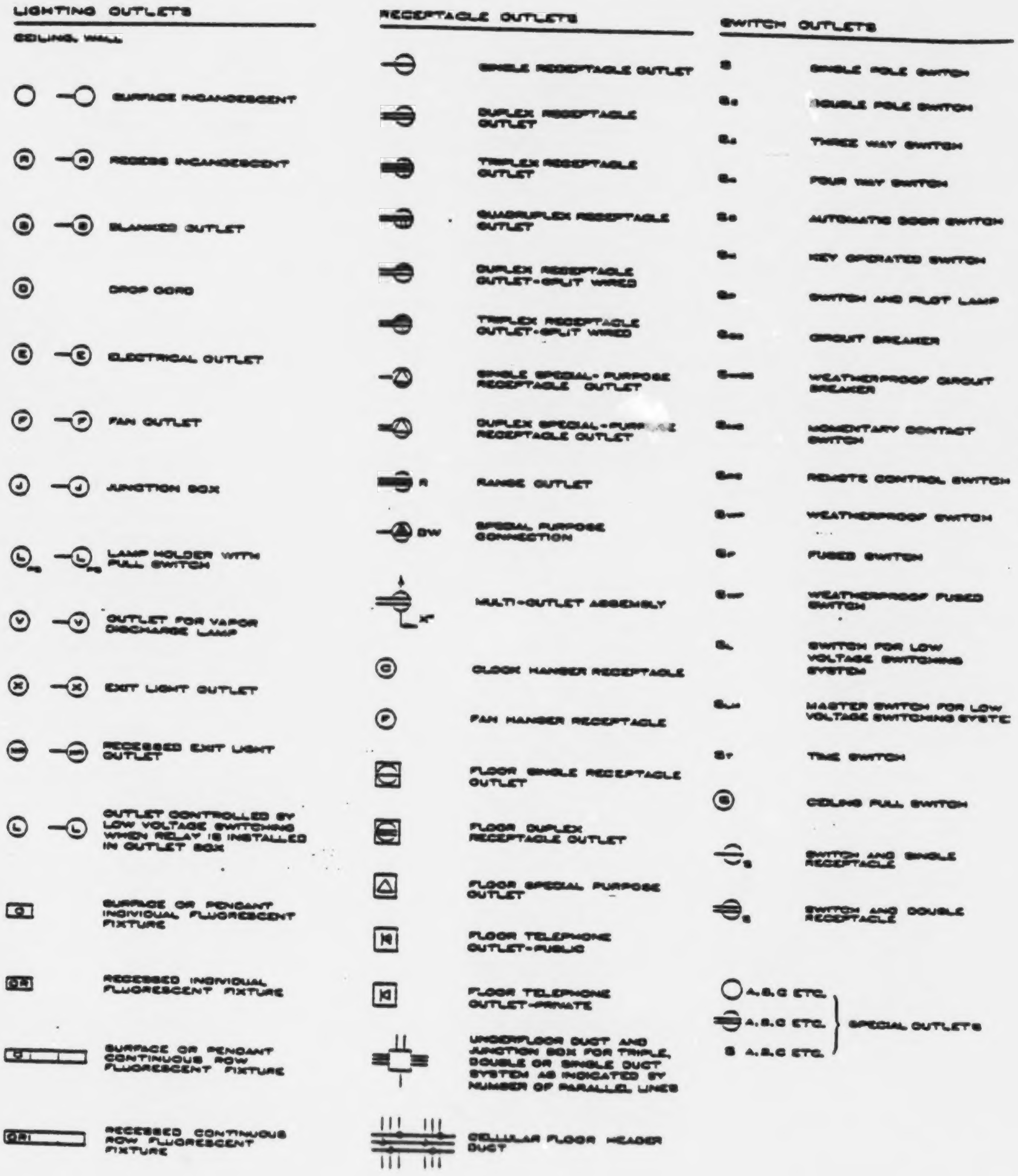
Branch Circuit; Concealed in Floor.

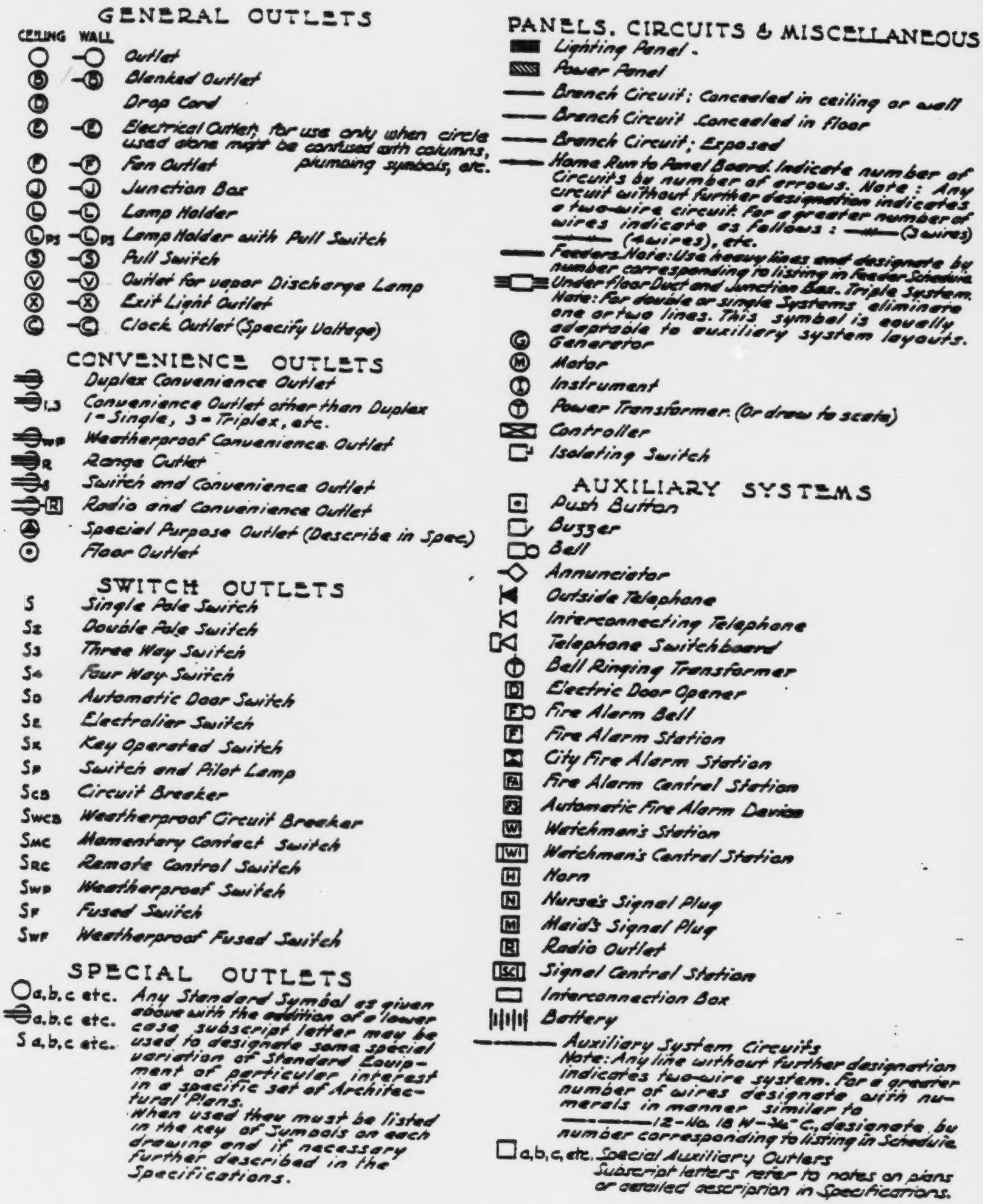
Branch Circuit; Exposed.

Home Run to Panel Board. Indicate number of Circuits by number of arrows.

Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows (3 wires) (4 wires), etc.

Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.


LIGHTING OUTLETS
CEILING, WALL
SURFACE INCANDESCENT
RECESS INCANDESCENT
BLANKED OUTLET
DROP CORD
ELECTRICAL OUTLET
FAN OUTLET
JUNCTION BOX
LAMP HOLDER WITH PULL SWITCH
OUTLET FOR VAPOR DISCHARGE LAMP
EXIT LIGHT OUTLET
RECESSED EXIT LIGHT OUTLET
OUTLET CONTROLLED BY LOW VOLTAGE SWITCHING WHEN RELAY IS INSTALLED IN OUTLET BOX
SURFACE OR PENDANT INDIVIDUAL FLUORESCENT FIXTURE
RECESSED INDIVIDUAL FLUORESCENT FIXTURE
SURFACE OR PENDANT CONTINUOUS ROW FLUORESCENT FIXTURE
RECESSED CONTINUOUS ROW FLUORESCENT FIXTURE
RECEPTACLE OUTLETS
SINGLE RECEPTACLE OUTLET
DUPLEX RECEPTACLE OUTLET
TRIPLEX RECEPTACLE OUTLET
QUADRUPLEX RECEPTACLE OUTLET
DUPLEX RECEPTACLE OUTLET-SPLIT WIRED
TRIPLEX RECEPTACLE OUTLET-SPLIT WIRED
SINGLE SPECIAL-PURPOSE RECEPTACLE OUTLET
DUPLEX SPECIAL-PURPOSE RECEPTACLE OUTLET
R
RANGE OUTLET
DW
SPECIAL PURPOSE CONNECTION
X"
MULTI-OUTLET ASSEMBLY
CLOCK HANGER RECEPTACLE
FAN HANGER RECEPTACLE
FLOOR SINGLE RECEPTACLE OUTLET
FLOOR DUPLEX RECEPTACLE OUTLET
FLOOR SPECIAL PURPOSE OUTLET
FLOOR TELEPHONE OUTLET-PUBLIC
FLOOR TELEPHONE OUTLET-PRIVATE
UNDERFLOOR DUCT AND JUNCTION BOX FOR TRIPLE, DOUBLE OR SINGLE DUCT SYSTEM AS INDICATED BY NUMBER OF PARALLEL LINES
CELLULAR FLOOR HEADER DUCT
SWITCH OUTLETS
S
SINGLE POLE SWITCH
S_2
DOUBLE POLE SWITCH
S_3
THREE WAY SWITCH
S_4
FOUR WAY SWITCH
S_D
AUTOMATIC DOOR SWITCH
S_K
KEY OPERATED SWITCH
S_P
SWITCH AND PILOT LAMP
S_{CB}
CIRCUIT BREAKER
S_{WCB}
WEATHERPROOF CIRCUIT BREAKER
S_{MC}
MOMENTARY CONTACT SWITCH
S_{RC}
REMOTE CONTROL SWITCH
S_{WP}
WEATHERPROOF SWITCH
S_F
FUSED SWITCH
S_{WF}
WEATHERPROOF FUSED SWITCH
S_L
SWITCH FOR LOW VOLTAGE SWITCHING SYSTEM
S_{LM}
MASTER SWITCH FOR LOW VOLTAGE SWITCHING SYSTEM
S_T
TIME SWITCH
CEILING PULL SWITCH
S
SWITCH AND SINGLE RECEPTACLE
S
SWITCH AND DOUBLE RECEPTACLE
A,B,C ETC.
A,B,C ETC.
S A,B,C ETC.
SPECIAL OUTLETS



GENERAL OUTLETS

CEILING	WALL	
○	–○	Outlet
Ⓑ	–Ⓑ	Blanked Outlet
Ⓓ		Drop Cord
Ⓔ	–Ⓔ	Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
Ⓕ	–Ⓕ	Fan Outlet
Ⓙ	–Ⓙ	Junction Box
Ⓛ	–Ⓛ	Lamp Holder
Ⓛ PS	–Ⓛ PS	Lamp Holder with Pull Switch
Ⓢ	–Ⓢ	Pull Switch
Ⓥ	–Ⓥ	Outlet for vapor Discharge Lamp
ⓧ	–ⓧ	Exit Light Outlet
Ⓒ	–Ⓒ	Clock Outlet (Specify Voltage)

CONVENIENCE OUTLETS

⦶	Duplex Convenience Outlet
⦶ 1,3	Convenience Outlet other than Duplex 1 = Single, 3 = Triplex, etc.
⦶ WP	Weatherproof Convenience Outlet
⦶ R	Range Outlet
⦶ S	Switch and Convenience Outlet
⦶–🅁	Radio and Convenience Outlet
◉	Special Purpose Outlet (Describe in Spec.)
⊙	Floor Outlet

SWITCH OUTLETS

S	Single Pole Switch
S_2	Double Pole Switch
S_3	Three Way Switch
S_4	Four Way Switch
S_D	Automatic Door Switch
S_E	Electrolier Switch
S_K	Key Operated Switch
S_P	Switch and Pilot Lamp
S_{CB}	Circuit Breaker
S_{WCB}	Weatherproof Circuit Breaker
S_{MC}	Momentary Contact Switch
S_{RC}	Remote Control Switch
S_{WP}	Weatherproof Switch
S_F	Fused Switch
S_{WF}	Weatherproof Fused Switch

SPECIAL OUTLETS

○a,b,c etc.
⦶a,b,c etc.
S a,b,c etc.

Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans.
When used they must be listed in the key of Symbols on each drawing and if necessary further described in the Specifications.

PANELS, CIRCUITS & MISCELLANEOUS

■	Lighting Panel.
▨	Power Panel
——	Branch Circuit; Concealed in ceiling or wall
——	Branch Circuit Concealed in floor
——	Branch Circuit; Exposed
——	Home Run to Panel Board. Indicate number of Circuits by number of arrows. Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows: —⫽— (3 wires) —⫻— (4 wires), etc.
——	Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule
≡▭≡	Underfloor Duct and Junction Box. Triple System. Note: For double or single Systems eliminate one or two lines. This symbol is equally adaptable to auxiliary system layouts.
Ⓖ	Generator
Ⓜ	Motor
Ⓘ	Instrument
Ⓣ	Power Transformer. (Or draw to scale)
⊠	Controller
⊐	Isolating Switch

AUXILIARY SYSTEMS

⊡	Push Button
▭	Buzzer
▭○	Bell
–◇	Annunciator
◀	Outside Telephone
◁	Interconnecting Telephone
▭◁	Telephone Switchboard
⊕	Bell Ringing Transformer
🄳	Electric Door Opener
🄵○	Fire Alarm Bell
🄵	Fire Alarm Station
⧓	City Fire Alarm Station
FA	Fire Alarm Central Station
▣	Automatic Fire Alarm Device
🅆	Watchman's Station
WI	Watchman's Central Station
🄷	Horn
🄽	Nurse's Signal Plug
🄼	Maid's Signal Plug
🅁	Radio Outlet
SC	Signal Central Station
▭	Interconnection Box
ǀǁǀǁ	Battery
——	Auxiliary System Circuits Note: Any line without further designation indicates two-wire system. For a greater number of wires designate with numerals in manner similar to ——12-No. 18 W-¾" C., designate by number corresponding to listing in Schedule
□a,b,c, etc.	Special Auxiliary Outlets Subscript letters refer to notes on plans or detailed description in Specifications.

9CFR 1910.120

HAZARDOUS WASTE OPERATIONS
AND
EMERGENCY RESPONSE
FOR
GENERAL SITE WORKERS
EQUIPMENT OPERATORS-LABORERS-SUPERVISORS

COURSE DESCRIPTION:

40 hours of initial training for general site workers such as equipment operators, general laborers and supervisory personnel engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards.

REFERENCES:

1. Hazardous Waste Operation and Emergency Response, 29 Code of Federal Regulations, Part 1910.120.

2. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

3. Module I: Employee Introduction to RCRA, Module II: Keeping Track of Hazardous Wastes, Module III: Protective Clothing and Equipment, Module IV: Handling Spills in the Work place, Hazardous Waste Safety, Asbestos Safety, (BUSINESS & LEGAL REPORTS).

4. Guide to Industrial Respiratory Protection,. NIOSH.

5. Recognizing and Identifying Hazardous Materials, National Fire Academy.

6. Asbestos Abatement Worker Training, Hazardous Materials Training and Research Institute.

7. Hazard Communication, UAW_GM.

8. Sampling and Analysis, HMT 260, HMTRI.

9. Emergency Response Guidebook, DOT P 5800.4.

10. Pocket Guide To Chemical Hazards, NIOSH.

11. American Red Cross Standard First Aid Manual.

12. Construction Radiation Worker Training, EITC.

13. Respirator Training Guide, EITC.

REQUIRED FILMS

Respiratory Training

1. "You could be next"
2. A review "The Fundamentals of Respiratory Protection"
3. Lung function
4. Reciation Natually
5. Atomic Structures
6. Biological Effects
7. Dosimetry
8. Waste Generation Reduction
9. Waste Experimental Reduction Facility
10. Anti C's P.P.E.
11. Alarms
12. Mistakes
13. Millard Roentger
    1. RMS, Roentgers, Alora
    2. Genetic Effects
    3. Deloyed Effects
    4. Contamination
14. Employee INTRO TO RCRA Module I
15. Keeping Track of Hazardous Waste Module II
16. Project Protection Equipment Module III
17. Handling spills in the Workplace Module IV
18. Hazardous Waste Safety
19. Asbestoes Safety
20. Asbestoes Handling Mistakes

SPECIFIC OBJECTIVE:

Students will be provided the necessary information and hands or practical experience to safely work in a hazardous environment.

ENABLING OBJECTIVES

1. Names of personnel and alternates responsible for site safety and health.
2. Safety, health and other hazards present on the site.
3. Use of personal protective equipment.
4. Safe use of engineering controls and equipment on the site.
5. Work practices by which the employee can minimize risks from hazards.
6. Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards.
7. Employee training assignments.
8. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.
9. Site control measures.
10. Decontamination procedures.
11. Emergency response plan.
12. Confined space entry procedures.
13. Spill containment.

Table of Contents

Unit 1. Employee Introduction to RCRA.

Unit 2. Keeping Track of Hazardous Wastes.

Unit 3. Protective clothing and equipment.

Unit 4. Handling Spills in the Workplace.

Unit 5. Hazardous Waste Safety.

Unit 6. Asbestos Safety.

Unit 7. Respirator Training.

Unit 8. Radiation Construction Worker Training.

Unit 9. Hazard Communication.

Unit 10. Red Cross Standard First Aid.

Unit 11. Site Related Hazards.

Unit 12. Planning and Organization.

Unit 13. Medical Surveillance.

Unit 14. Site Characterization.

Unit 15. Air Monitoring.

Unit 16. Site Controls.

Unit 17. Decontamination.

Unit 18. Handling Drums and Other Containers.

Unit 19. Site Emergencies.

UNIT 1

EMPLOYEE INTRODUCTION TO RCRA & CERCLA

SPECIFIC OBJECTIVE:
At the completion of this unit a student will be able to: explain the requirements of the Hazardous Materials and Waste Handling Safety Requirements as listed in 29CFR 1910.120.

ENABLING OBJECTIVES:

1. Explain the requirements of 29CFR 190.120.

2. Explain the basic principles of the RCRA ACT.

3. Explain the basic principles of CERCLA.

4. Explain the purpose of OSHA and EPA.

5. Explain the importance of being safety conscious on the job.

6. Define Hazardous Waste.

7. Evaluate risks associated with the job.

8. Explain the importance of protecting yourself from hazards.

9. Explain how we protect ourselves against the dangers associated with the four categories of hazardous waste.

10. Explain the importance of proper protective clothing and equipment.

11. Explain the importance of emergency planning.

12. Understand the importance of proper documentation.

UNIT 2

KEEPING TRACK OF HAZARDOUS WASTES

SPECIFIC OBJECTIVE:

At the completion of this unit the student should be able to understand and explain the importance of proper record keeping and the basic requirements outlined by the EPA for the RCRA and CERCLA.

ENABLING OBJECTIVES:

1. Explain the importance of the hazardous waste identification numbering system.
2. Identify a hazardous waste manifest.
3. Identify an MSDS.
4. Explain the importance of the identification label.

UNIT 3

PROPER PROTECTIVE EQUIPMENT

SPECIFIC OBJECTIVE:

At the completion of this unit a student will be able to explain the importance of proper protective equipment and how and when to use it to shield or isolate individuals from the chemical, physical, biologic hazard that may be encountered at a hazardous waste site.

ENABLING OBJECTIVE:

At the completion of this unit a student should be able to:

1. Explain how protective equipment protects you.
2. Explain the four levels of protection.
3. Explain the importance of Respirator protection.
4. Explain the importance of practicing hygiene on the job.
5. Explain the importance of a written proper protective equipment program.
6. Explain the proper methods used for selection of respiratory equipment.
7. Explain the proper methods for selection of protective clothing and accessories.
8. Explain the importance of proper use of proper protective equipment.
9. Heat stress and other physiological factors.

UNIT 4

HANDLING SPILLS IN THE WORKPLACE

SPECIFIC OBJECTIVE:

At the completion of this unit a student should understand and be able to explain the importance of proper handling of spills in the workplace.

ENABLING OBJECTIVES:

At the completion of this unit a student should be able to explain and pass a test on:

1. The importance of spill prevention.
2. What to do if there is a spill.
3. Proper spill response.
4. The importance of proper protective clothing and equipment.
5. Proper spill control equipment.
6. Stabilizing the Spill.
7. Decontamination procedures.

UNIT 5

HAZARDOUS WASTE SAFETY

SPECIFIC OBJECTIVE:

At the completion of this unit a student should be able to explain the importance of:

1. Site Characterization and control.
2. Site hazard determination.
3. Proper personnel protective equipment.
4. Proper level of protection for the associated hazard.
5. Proper decontamination procedures.
6. Proper work practices and engineering controls.
7. Confined Space entry procedures.
8. Proper emergency response procedures.
9. Proper medical surveillance.

UNIT 6

ASBESTOS SAFETY

SPECIFIC OBJECTIVE:

At the completion of this unit a student should be able to explain what asbestos is, how to safely work with it and the hazards associated with it.

SPECIFIC OBJECTIVES:

At the completion of this unit a student should be able to explain :

1. What is Asbestos?

2. How Asbestos enters the body?

3. What health hazards are associated with asbestos.

4. The dangers of Smoking and asbestos.

5. Basic exposure levels.

6. The importance of signs and labels related to asbestos.

UNIT 7

RESPIRATOR TRAINING

SPECIFIC OBJECTIVE:

The goals and objectives of the EITC program in respirator training is to provide training to area hazardous material workers in the proper and safe use of respirator equipment. Familiarization of specific respirators, their uses and limitations, requirements for proper fit, physical requirements, and facial conditions are some to the topics covered. Upon conclusion of the classroom phase of respirator training, the workmen will be test fitted qualitatively and quantitatively and issued a card which will identify the prescribed respirator fit.

ENABLING OBJECTIVES:

At the completion of this unit the student should be able to:

1. Explain the requirements of the American National Standards Institute Document Z88.2-1980.
2. Explain training requirements of the respirator wearer.
3. Explain the requirements for annual retraining.
4. Explain Protection Factors.
5. Identify face pieces, hoods and bubble suits.
6. Identify respirator types.
7. Explain air purifying and air supplying respirators.
8. Explain wearer requirements and limitations.
9. Explain Qualitative fit testing.
10. Explain positive and negative pressure testing.
11. Explain Quantitative fit testing.

BEST COPY AVAILABLE

12. Select, inspect, do, and pass a quantitative fit test with a full face air purifying respirator.
13. Explain the limitation and deficiencies of air purifying respirators.

15. Demonstrate the ability to properly inspect, done. and work with an SCBA unit, remove and properly store and report its use.

UNIT 8

RADIATION CONSTRUCTION WORKER TRAINING.

SPECIFIC OBJECTIVE:

The main goal and objective of the Radiation Construction Training is to prepare the student to work safely in radiological conditions while keeping their exposure as low as reasonably achievable.

ENABLING OBJECTIVE:

At the completion of this unit the student will be able to explain the following:

1. Natural Background Radiation
2. Man-made sources of radiation
3. Atomic Structure
4. Ionizing Radiation
5. Radioactivity
6. Exposure terms
7. ALARA Policy
8. DOE Radiation Protection Guide
9. Contractor Administrative Dose Guide
10. Biological Effects
11. Female Radiation Worker Exposure Policy
12. Radiation Monitoring Programs and Procedures
13. Dosimetry
14. Whole Body count and Bioassay Program
15. Contamination
16. System Containment
17. The Detection of Contamination
18. Units of Measurement
19. Personnel Monitoring
20. Personnel Decontamination
21. Radiation Survey Instrumentation
22. Basic Protective Measures
23. Access Control/Construction Safe Work Permit
24. Contaminated Area Work Practices
25. Contamination Zone Requirements
26. Segregation and Minimization of Radiological Waste
27. Emergency Actions

UNIT 9

HAZARD COMMUNICATION:

SPECIFIC OBJECTIVE:

The main goal and objective of the Hazard Communication Unit is to prepare the student to identify the components of a hazardous communication program and be aware of the worker training program.

ENABLING OBJECTIVE:

At the completion of this unit each student will be able to do the following:

1. Recognize chemical and physical properties of hazardous materials and methods that can be used to detect the the presence and or release of chemicals.

2. Recognize the physical hazards of chemicals, fire, explosion, etc.

3. Recognize health hazards, including signs and symptoms of exposure, associated with exposure to chemicals and medical condition known to be aggravated by exposure to the chemical

4. Procedures to protect against hazards (personal protective equipment required, proper use and maintenance; work practices or methods to assure proper use and handling of chemicals and procedures for emergency response).

5. Work procedures to follow to assure protection when cleaning hazardous chemical spills and leaks.

6. Where MSDS's are located, how to read and interpret the information on both labels and MSDS's, and how employees may obtain additional hazard information.

UNIT 10

RED CROSS STANDARD FIRST AID TRAINING.

SPECIFIC OBJECTIVE:

The main goal and objective is that each student will become familiar with all emergency action principles. Each student will have a working knowledge of First Aid Training.

ENABLING OBJECTIVE:

At the completion of this course the student will be able to do the following:

1. Survey the scene.
2. Do a primary survey of the victim.
3. Phone the emergency medical services (EMS) system for help.
4. Do a secondary survey of the victim.
5. Recognize and perform rescue breathing.
6. Recognize and perform necessary procedures to help a victim with a blocked air passage way.
7. Recognize and perform necessary procedures dealing with cardiac arrest victims.
8. Proper procedures for control of bleeding and shock.
9. Proper care of chemical burns to the eye and nose areas.
10. Proper care of human, animal, snake, and insect bites. Proper response to allergic reactions.
11. Proper care of Fractures, Dislocation, Sprains, and Strains.
12. Proper care of swallowed, inhaled, or absorbed poison.
13. Care of victim suffering from insulin shock or diabetic coma.
14. Proper care of a stroke victim.
15. Proper care for a victim of a seizure.
16. Proper care of Heat Emergencies (heat stroke, heat exhaustion) and Cold Emergencies (hypothermia and frost bite.)
17. Proper rescue procedures.

SITE RELATED HAZARDS

SPECIFIC OBJECTIVE:
At the completion of this course a student should be able [illegible] explain and identify the hazards found on the work site.

ENABLING OBJECTIVE:

At the completion of this course the student should be able to explain the hazards that are a function of the nature of the site as well as the consequence of the work that is being performed. They include:

1. Chemical Exposure
2. Fire and Explosion
3. Oxygen Deficiency
4. Ionizing Radiation
5. Biologic Hazards
6. Safety Hazards
7. Electrical Hazards
8. Heat Stress
9. Cold Exposure
10. Noise

UNIT 12

PLANNING AND ORGANIZATION

SPECIFIC OBJECTIVE:

At the completion of this unit a student should be able to identify and explain the Three Aspects of Planning. Each student should be able to prepare an efficient Work Plan including the objectives of site operations and the logistics and resources required to achieve the goals.

ENABLING OBJECTIVE:

At the completion of this unit student should be able to identify and explain the following:

ORGANIZATIONAL STRUCTURE

1. Identify a leader who has the authority to direct all activities.
2. Identify the other personnel needed for the project, and assign their general functions and responsibilities.
3. Show lines of authority responsibility, and communication.
4. Identify the interface with the response community.

WORK PLAN

1. Review available information (site records, waste inventories, generator and transporter manifest, site photos and state and local environmental and health agency records.)
2. Define work objectives

3. Determine methods for accomplishing the objectives, e.g., sampling plan, inventory, disposal techniques.
4. Determine personnel requirements
5. Determine the need for additional training of personnel. Evaluate their current knowledge/ skill level against the tasks they will perform and

SITE SAFETY PLAN

1. Name key personnel and alternates responsible for site safety.

2. Describe the risks associated with each operat[illegible] conducted.

3. Confirm that personnel are adequately trained to perform their job responsibilities and to handle the specific hazardous situations they may encounter.

4. Describe the protective clothing and equipment to be worn by personnel during various site operations.

5. Describe any site-specific medical surveillance requirements.

6. Describe the program for periodic air monitoring, personnel monitoring, and environmental sampling.

7. Describe the actions to be taken to mitigate existing hazards.

8. Define site control measures and include a site map.

9. Establish decontamination procedures for personnel and equipment.

10. Set forth the site's Standard Operating Procedu[illegible]s (SOPs) SOPs are those activities that can be standardized such as decontamination and respirator fit testing.

11. Set forth a Contingency Plan for safe and effective response to emergencies.

UNIT 13

MEDICAL SURVEILLANCE

SPECIFIC OBJECTIVE:

The main goal and objective of the Medical Surveillance Unit is to stress the importance of the medical control program. The medical program is essential to assess and monitor workers' health and fitness both prior to employment and during the course of work. The student will learn to keep accurate records for future reference and to be aware of the standards recommended by OSHA.

ENABLING OBJECTIVES:

At the completion of this unit each student will be able to explain the following:

1. Medical surveillance through pre-employment screening, periodic medical examinations, and terminal examinations.
2. Treatment of a) emergency and b) non-emergency situations.
3. Record Keeping
4. Program Review

UNIT 14

SITE CHARACTERIZATION

SPECIFIC OBJECTIVE:

The main goal and objective of the Site Characterization Unit is to provide the information needed to identify site hazards and to select worker protection methods.

ENABLING OBJECTIVES:

At the completion of this unit each student will be able to characterize hazardous materials and waste sites by explaining methods of:

1. Conducting onsite characterization, gathering information away from the site, conduct reconnaissance from the site perimeter.
2. Conduct the onsite surveys.
3. Preform ongoing monitoring and providing continuous sources of information about site conditions.
4. Documentation of information.
5. Hazard Assessment

UNIT 12

AIR MONITORING

SPECIFIC OBJECTIVE:

The main goal and objective of the Air Monitoring Unit is to identify and quantify airborne contaminants in order to determine the level of worker protection needed.

ENABLING OBJECTIVE:

At the completion of this unit each student will be able to explain the use of:

1. Onsite use of direct-reading instruments.
2. Laboratory analysis of air samples obtained by gas sampling bag, filter, sorbent, or wet contaminant collection methods.
3. The variables of Hazardous Waste Site Exposure.

UNIT 16

SITE CONTROLS

SPECIFIC OBJECTIVE:

The main goal and objective of the Site Controls Unit is to minimize potential contamination of workers, protect the public, from the sites hazards, and prevent vandalism.

ENABLING OBJECTIVE:

At the completion of this unit each student will be able to explain several site control procedures which can be implemented to reduce worker and public exposure to chemical, physical, biologic, and safety hazards through:

1. Compiling a site map.
2. Preparing the site for subsequent activities.
3. Establishing work zones.
4. Use of the buddy system when necessary.
5. Establishing and strictly enforcing documentation procedures of both personnel and equipment.
6. Establishing site security measures.
7. Setting up communication networks.
8. Enforcement of safe work practices.

UNIT 17

DECONTAMINATION

SPECIFIC OBJECTIVE:

The main goal and objective of the Decontamination Unit is to inform the student of the importance of using the proper processes for removing or neutralizing contaminants that have been accumulated on equipment and personnel.

ENABLING OBJECTIVE:

At the completion of this unit each student will be able to:

1. Determine the number and lay out of decontamination stations required for proper site protection.
2. Determine the decontamination equipment needed
3. Determine appropriate decontamination methods.
4. Explain procedures required to prevent contamination of clean areas.
5. Explain methods and procedures used to minimize worker contact with contaminants during removal of personal protective clothing and equipment.
6. Explain methods for disposing of clothing and equipment that are not completely decontaminated.

UNIT 13

HANDLING DRUMS AND OTHER CONTAINERS

SPECIFIC OBJECTIVE:

The main goal and objective of the Handling Drums and Oth[illegible] Hazardous Waste Containers Unit is to establish standards for storing, containing, and handling chemical and containers, and for maintaining equipment used for handling these said materials.

ENABLING OBJECTIVE:

At the completion of this unit each student should be able to explain methods used for the safe:

1. Inspection of any containers found on a hazardous waste site.

2. Creating a preliminary plan which specifies the extent of handling necessary, the personnel selected for the job, and the most appropriate procedures based on the hazards associated with the probable drum contents as determined by visual inspection.

3. For safe handling of said containers and responding to any obvious problems that might impair worker safety and organizing drums into staging areas, stacking and unstacking drums and orienting drums.

4. Proper opening procedures

5. Proper sampling procedures.

6. Characterizing to obtain the data necessary to determine how to safely and efficiently package and transport the waste for treatment and/or disposal.

7. Proper staging procedures.

8. Bulking procedures (mixing together various chemicals into bulk containers)

9. Proper shipment procedures according to DOT regulations (49 CFR parts 171-178) and EPA regulations (40 CFR part 263)

10. Special case problems including tanks and vaults to find space entry and compress gas cylinders.

UNIT 19

SITE EMERGENCIES

SPECIFIC OBJECTIVE:

The main goal and objective of the Site Emergencies unit is to outline important factors to be considered when planning for and responding to emergencies.

ENABLING OBJECTIVE:

At the completion of this unit each student should be able to explain the importance of:

1. A written contingency plan.

2. Defining emergency response roles of both offsite and onsite personnel.

3. Training required for all personnel either working or visiting a hazardous waste site.

4. The importance of being constantly alert for indicators of potentially hazardous situations and immediate recognition and possible prevention of any hazardous exposures.

5. The importance of proper communication both internal and external.

6. The importance of proper site mapping

7. Maintaining safe distances and refuges from hazardous waste sites.

8. Proper site security and controls.

9. Evacuation routes and procedures.

10. The use of proper emergency response equipment.

11. The proper medical treatment and first responder first aid techniques.

12. Proper emergency response procedures.

13. Proper documentation of any and all incidents resulting in personal injury, onsite property damage or damage to the surrounding environment.

F 1-3

DAY 5-Practical Exercise

Removal of "PCB" Containing Barrels (Buried)

The purpose of this exercise is to aquaint you with some of the procedures used in hazardous waste clean-up. Each site is unique, involving different hazards and, consequently, different methods of clean-up and different levels of personnel protection. The single most important concept in hazardous waste removal is **safety.** Every plan must be implemented with maximum safety and minimum exposure.

WORK OBJECTIVES. Today we will be ~~removing~~ sampling two barrels containing suspected PCB-contaminated oil. ~~The barrels are buried approximately 1.5 feet underground~~. It is not known whether the barrels have leaked or not, so we will assume they have and wear the proper protective clothing. ~~First, the barrels have to be uncovered. This will entail the use of a backhoe until near barrels, then shoveling dirt until barrels are uncovered~~. The oil will be sumped out into lined waste barrels, then the empty barrels will be brought up and placed on a tarp, pending proper disposal.

What is PCB? (See attached sheet.) Despite these known effects, PCBs are relatively easy to protect against. According to the NIOSH (National Intstute for Occupational Safety and Health), the TLV (Threshold Limit Value) for PCB is, for less than 42% chlorine, $1 mg/m^3$; for greater than 42% chlorine, $.5 mg/m^3$. These values are very high. In other words, you would be able to see the PCB floating around, which, I assure you, is not the case in this operation.

Personnel protective clothing required. The protective clothing needed is determined by the type of hazard involved and the concentration of the hazardous waste(s). This particular job will require a level "~~C~~ A" protective posture. This includes:

-Full-facepiece, air-purifying, canister-equipped respirator. [illegible]

SCBA - [illegible]

-Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit).

-Inner and outer chemical-resistant gloves.

-Chemical-resistant safety boots/shoes.

-Hard hat.

-~~Two-way radio communications.~~

STEP-BY-STEP PROCEDURES

I. Locate and set up site.
   A. Use metal detector to pinpoint location of barrels.
   B. Bring back-hoe and all other needed materials to location.
   C. Segregate area using yellow safety rope and caution signs.
   D. Lay out tarps and place lined barrels in area that is available to pump.
   E. Set up decon area according to flowchart.

II. Don proper protective clothing.
   A. Put on coveralls, taking care to avoid rips or punctures.
   B. Put on boots and let pant legs hang over.
   C. Put on glove liners and first pair of gloves, let sleeves hang over.
   D. Tape pant legs to boots and tape sleeves to gloves.
   E. Don respirator. Be sure to do thorough positive and negative pressure tests. If youu are having any difficulties, take off the mask and check it.
   F. Pull hood over respirator and tie snugly.
   G. Don't forget your hard hat!
   H. Put on last pair of gloves and tape to clothing.

SCBA procedures too.

III. Perform remedial action.

- A. After locating barrels with metal-detector, begin backhoe operations.
  - 1. Back-hoe towards barrels to avoid spreading possible contamination of clean areas.
  - 2. All ground personnel should avoid getting in the way of the backhoe.
  - 3. A sample of the 0-6" ground level will be taken at this time.
- B. Remove any excess dirt from around barrels with shovels.
- C. Inspect barrels for any marking, labeling, leaking, bulging, or any other damage. Also check the type of cover on barrel.
- D. Carefully open barrel or remove bung to allow access for sampling. Take sample using glass rod with suction device (don't use mouth to begin suction).
- E. Pump contents into lined barrel, avoiding spills or leaks.
- F. Repeat procedures D. and E. for other barrel.
- G. Place emptied barrel on tarp and cover to prevent loss of any remaining contaminant.
- H. Cover and label transport barrel with hazardous material warnings.
- I. Sample ground where barrels were previously located.
- J. Spray all equipment with water to remove any visible dirt.

IV. Egress

- A. Decon outer garments.
- B. Remove boot covers and outer gloves (will simply spray down boots for this exercize).
- C. Remove boots, gloves and outer garments.
- D. Remove mask.

V. Break/ sample analysis in lab.

VI. End of exercize.

- A. Tear down area and put everything away.
- B. After-exercize discussion.

Checklist of needed materials for PCB mock-up

(Not listed in order of importance)

one barrel (for gloves, rags, etc.) lined
two barrel (with oil) buried
two barrel (lined) for "shipment"
two large tarps
protective clothing, to include:
    coveralls (tyvek, with hoods)
    rubber boots
    rubber gloves with liners
    full-face respirators with combination filters / SCBH
    tape
~~back hoe~~
~~two shovels~~
PCB stickers, hazardous materials stickers (Great Western Chemicals)
glass bottles with lids (4-6 oz.)
yellow construction tape with poles or pylons
~~sump with hose~~
lots of cleaning rags
hose hooked to water supply with spray nozzle
~~metal detector~~ ([illegible])
absorbant (kitty litter)
fire extinguisher
first aid kit
various logs (access/egress, shipping, analysis)
1'x3'x6" plastic pan (to rinse off boots when leaving area
hardhats

What have I forgotten?

North Idaho College

NORTH IDAHO COLLEGE

PROPOSAL

HARD ROCK MINING PROGRAM

BERNARD L. KNAPP
COORDINATOR

1000 West Garden Avenue • Coeur d'Alene, Idaho 83814 • (208) 769-3300

MINER TRAINING PROGRAM

STATEMENT OF NEED

The Idaho Employment Labor Report, Department of Employment, Bureau of Research and Analysis, April, 1988 states:

> "Employment increases in the mining sector during March and April was a continuation of expansion at both the metal and nonmetallic mines. The mines in the Silver Valley added additional workers as Sunshine and Hecla were in full operation during this time period. The phosphate mines in southeast Idaho were gearing up following a winter slowdown. Also a turn around in the molybdenum market has resulted in 138 additional workers being hired at the Cyprus Thompson Creek mine since January 1988.
>
> The big news in the mining industry was the announced reopening of the Bunker Hill and Crescent mines on May 23. The mines will open in 90 days with a labor force of about 70 workers increasing to 200 within a year. A special article on Bunker Hill is featured in this month's newsletter. For an industry that was dying a year ago, mining in Idaho is making a comeback as a basic industry."

INDUSTRY SUPPORT

In June 1988 five mining companies in the Silver Valley mining district requested assistance in training underground hard rock miners. The five companies and several mine supply companies offered to contribute equipment, tools and supplies. Three of the largest mining companies requested in writing a training program and at the same time outlined the major course content. (See attached letter from Bunker Hill mining, Sunshine Mining and Fausett International.)

MINER CURRICULUM

I. ORIENTATION AND SAFETY

1. Statutory rights of miner's and their representatives under the act; authority and responsibility of supervisors.

2. Personal protective equipment
    a. Head protection with lamp and battery
    b. Eye protection
    c. Ear protection
    d. Foot protection
    e. Respirator protection
    f. Miners belt

3. Self rescue and respiratory protection

4. Introduction to mining

5. Entering and leaving the mine; transportation and communications

6. Mine map; escape ways, emergency evacuation and barricading

7. Roof control and ventilation plans

8. Hazard recognition

9. Lock out procedures: Electrical Hazards

10. Clean up and rock dusting

11. Haulage safety

12. Health
    a. Mine gases and dust
    b. Noise and noise reduction and control
    c. Physical examination

13. Mine terminology

14. Back safety in the mining environment

15. First Aid and CPR
    a. Breathing
    b. Bleeding
    c. Shock
    d. Fractures and dislocations
    e. Burns
    f. Transportation
    g. CPR

16. Introduction to the work environment
    - a. Walk around of either the Sunshine or Bunker Hill Mines
    - b. Walk around at the Atlas Mine Training Lab

II. IDENTIFICATION OF ORE PRODUCTS

1. Lead

2. Silver

3. Zink

4. Others
    - a. Weight
    - b. Appearance
    - c. Hardness
    - d. Grading

III. INSTALLATION OF GROUND SUPPORT SYSTEMS

1. Tools
    - a. Hand tools
      (Axe, doublejack, shovel, nails)
    - b. Electric tools
    - c. Air powered tools

2. Setting post and erect staging

3. Install back lagging and/or cribbing

4. Install side lagging and blocking

5. Install booms with lagging

6. Install mechanical ground support systems
    - a. Elliptical bolts
    - b. Split bolts
    - c. Point anchor bolts, plates and shells

IV. INSTALLATION OF AUXILARY EQUIPMENT

1. Install ventilation equipment

2. Install air and/or water lines

3. Build any needed chutes

4. Build any needed slusher ramp

5. Install pneumatic water pumps
6. Build any needed bulkhead and/or grizzly

V. INSTALLATION OF HAULAGE TRACK

1. Inspect work area for hazards and make it safe
2. Locate center points and track grade points
3. Measure distance for track ties
4. Dig ditches and install ties
5. Place rails on ties
6. Connect rails with plates
7. Use rail gage testing spacing
8. Spike down rail
9. Install switch assembly
10. Use rail bender when necessary
11. Drive locomotive and ore cars to test installation

VI. EQUIPMENT OPERATION

1. Adjust and operate air chain saw
2. Safety check and operate jackhammer
3. Set up and operate jackleg drill
4. Conduct service check and operate mucking machine
5. Set up and operate slusher (air and electric)
6. Set up and operate tugger
7. Set up and operate stoper
8. Set up and operate ANFO loader
9. Set up and operate moil
10. Service and operate locomotive and ore cars

11. Service, start and operate air compressors
12. Connect and safety lock air hoses
13. Check and fill line oilers
14. Shut down and service procedures for all equipment

VII. DRILLING PROCEDURES

1. Select and proper lengths of drill steel and sharp bits
2. Safety check of all equipment and air hoses
3. Fill line oiler
4. Insert drill steel and start to drill
5. Collar hole at reduced speed
6. Drift rounds
7. Raise rounds
8. Stope rounds
9. Patterns and angles and depth of drill holes

VIII. LOADING AND BLASTING

1. Storage of explosive (power and primers)
2. Selection of explosives, primer cord and ANFO
3. Patterns for detonation of holes
4. Patterns for wiring and loading holes
5. Methods of detonation
6. Pre-blasting safety check
7. Inspect for holes that did not detonate. (misfire)
8. Methods for safe handling of misfires

COURSE OBJECTIVE

The objective of this program is to train persons in underground mining consistent with the skills for entry level miners in Silver Valley, Idaho.

It has been proven that the mining industry is a dangerous occupation. For that reason total safety habits have to be developed to maintain proper working conditions for a safe but productive operation. A productive operation is second only to a safe working environment. All training is conducted under the "Safety First" mode of operation. Skill development is extremely important, but only under a attitude of performing in a safe manner.

INSTRUCTIONAL OBJECTIVE

1. Safety

Positive attitude towards safety can only be evaluated by the outward behavior of the particpants. Conducting all job task in a safe and conscious manner is a major instructional objectives.

2. Identification of Ore Products

The participants shall identify the basic mineral products of the Silver Valley.

3. Ground Support Systems

Proper use of hand, electric and air tools in the process of erecting timbers and shoring while making a mine a safe place in which to work.

4. Auxilary Equipment

Installing ventilation, air and water lines, chutes, slusher ramps, pneumatic water pumps, etc.

5. Haulage Track

Installation of ties and track for locomotive and ore cars.

6. Equipment Operation

Set up, operate and maintain air and power equipment. Examples: jackhammer, jackleg drill, mucking machine, slusher, tugger, stoper, moil, locomotive, air compressors, line oilers. etc.

7. Drilling Procedures

Set up and drilling of different drill hole patterns for preparation of explosives.

8. Loading and Blasting

Demonstrate safe storage and transporation of explosives. Demonstrate safe loading of powder, use of primers, techniques of using primer cord and loading holes with ANFO.

EQUIPMENT

1. Compressor (2)
2. Jackleg drill
3. Jackhammer
4. Mucking machine
5. Slusher
6. Tugger
7. Stoper
8. ANFO loader
9. Moil
10. Locomotive and ore cars
11. Electric fans
12. Truck and trailers
13. Timber trucks
14. Tanner Gas dispenser
15. Track rails
16. Mine lights
17. Underground charger
18. Battery hydrometer
19. Electric boxes
20. Transformer
21. Desk and Chairs
22. Water pumps

TOOLS

1. Chain saw
2. Axe
3. Double jack
4. Shovel
5. Scaling bar
6. Track jack
7. Drill steel
8. Line oilers
9. Bull hose
10. Powder poles
11. Impact wrenches

SUPPLIES

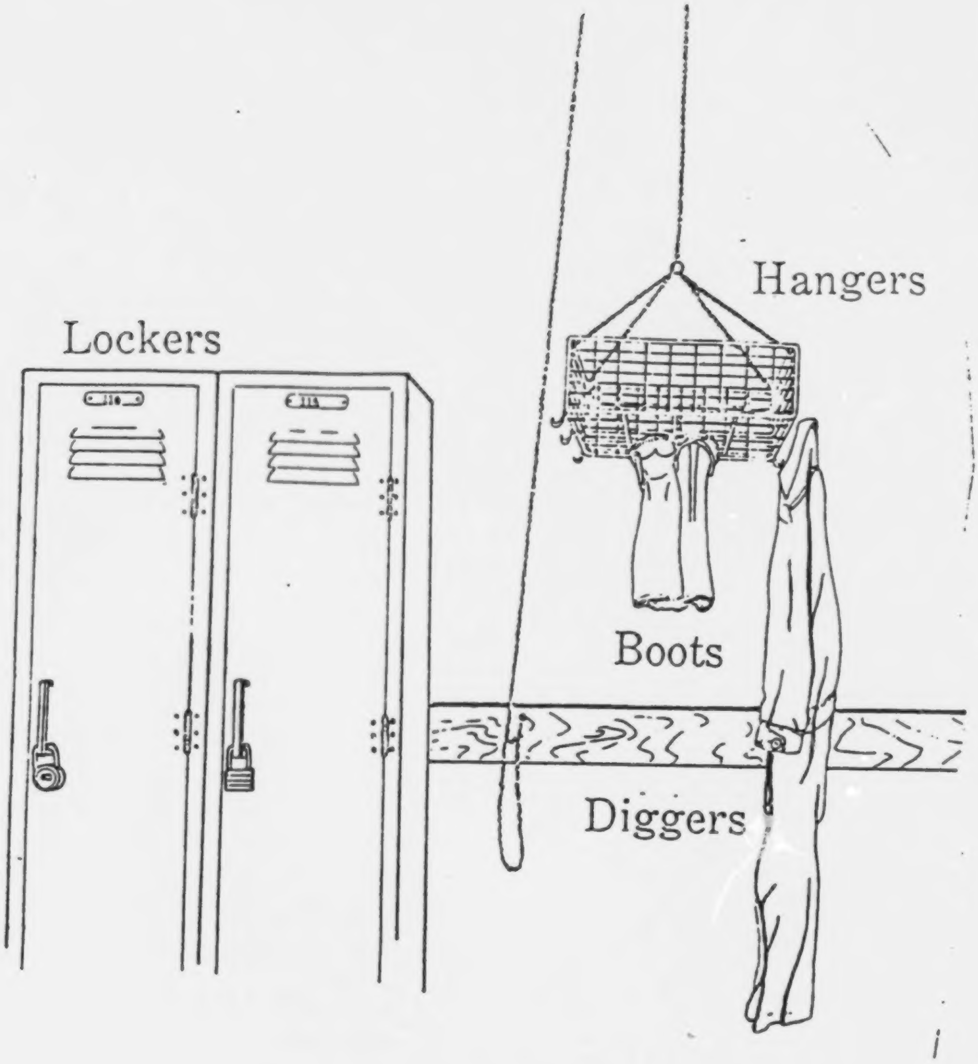
1. Mine timbers
2. Lagging
3. Rail ties
4. Mine wedges
5. Cap lamps
6. Rock bolts
7. Rock bolt anchor shells
8. Rock bolt plates
9. Rock bolt mats
10. Sleeve blocks
11. Pipe fittings
12. Water valves
13. Nuts and bolts
14. Rail spikes
15. Nails
16. Fish plates
17. Rail switch frogs
18. Cable
19. Drill bits

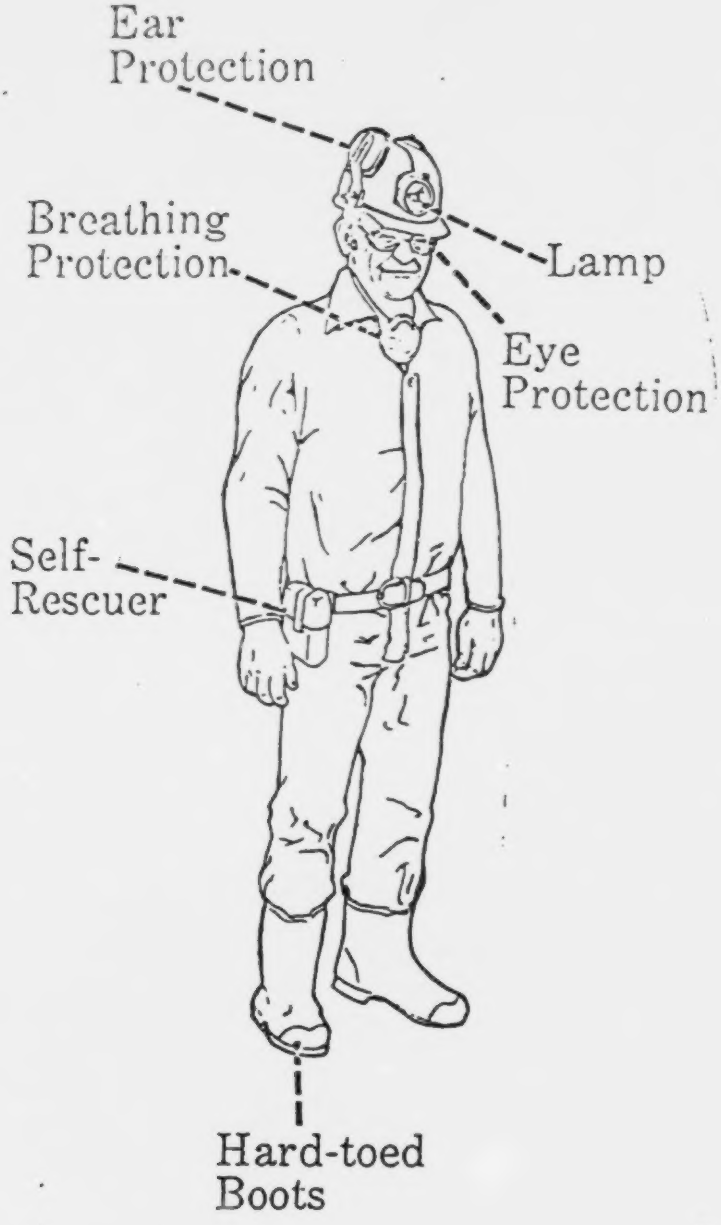
WRITTEN MATERIAL

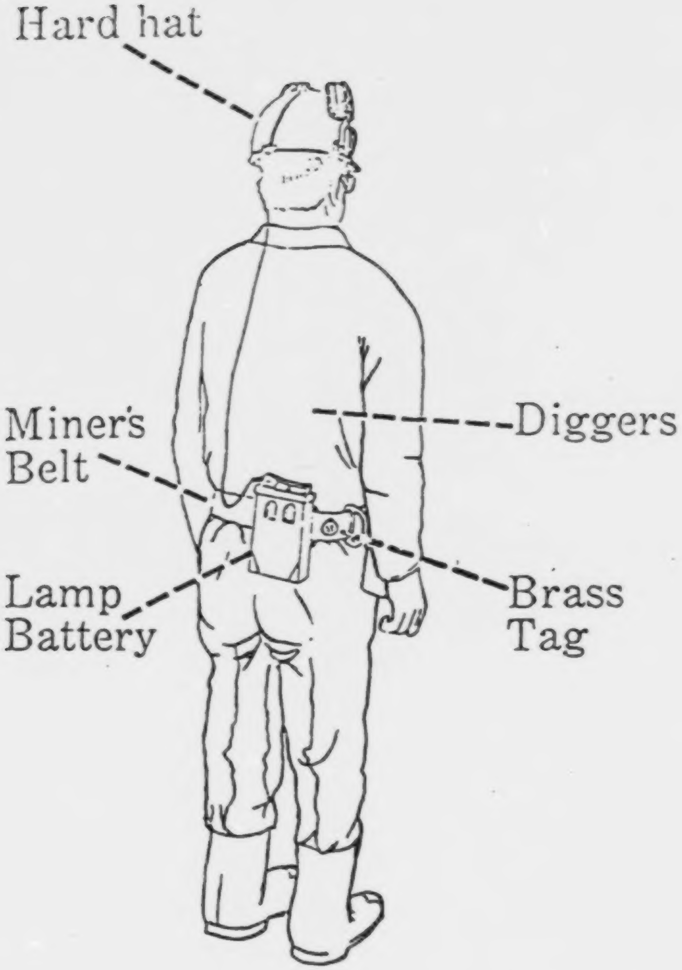
1. Rights of miners, MSHA publication
2. Fault free analysis
3. Accident investigation
4. Heat stress in mining
5. Job safety analysis
6. Gases in the mine environment
7. Handbook on explosives
8. Non-L primer handbook

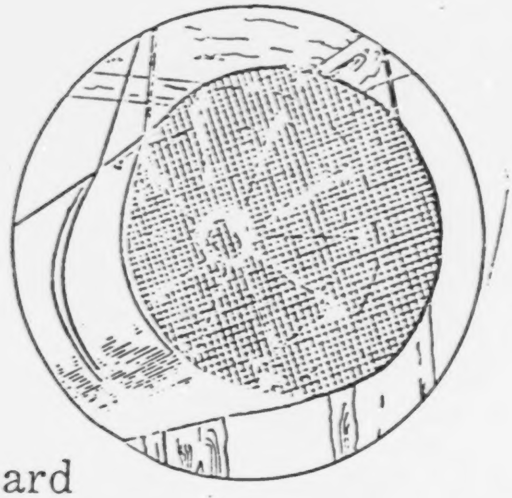
AUDIO/VISUAL

1. Material handling - a lifting problem
2. Safety belt demonstration
3. CPR film
4. The worst accident
5. Mine emergency (underground)
6. Surface emergency
7. Numerous in house video footage on mining


Hangers
Lockers
Boots
Diggers


Ear Protection
Breathing Protection
Lamp
Eye Protection
Self-Rescuer
Hard-toed Boots


Hard hat
Miner's Belt
Diggers
Lamp Battery
Brass Tag

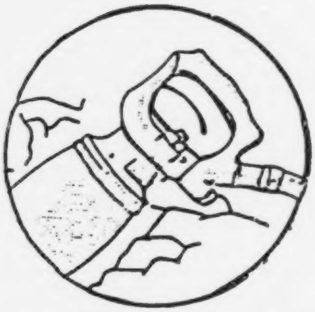


-01

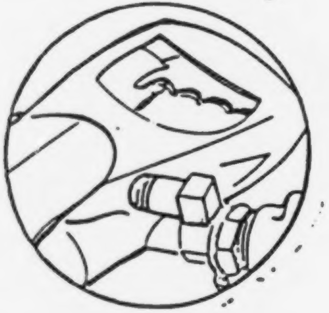
Fan Guard

Shown below are hand-held tools which require constant hand or finger pressure in order to operate.

-02

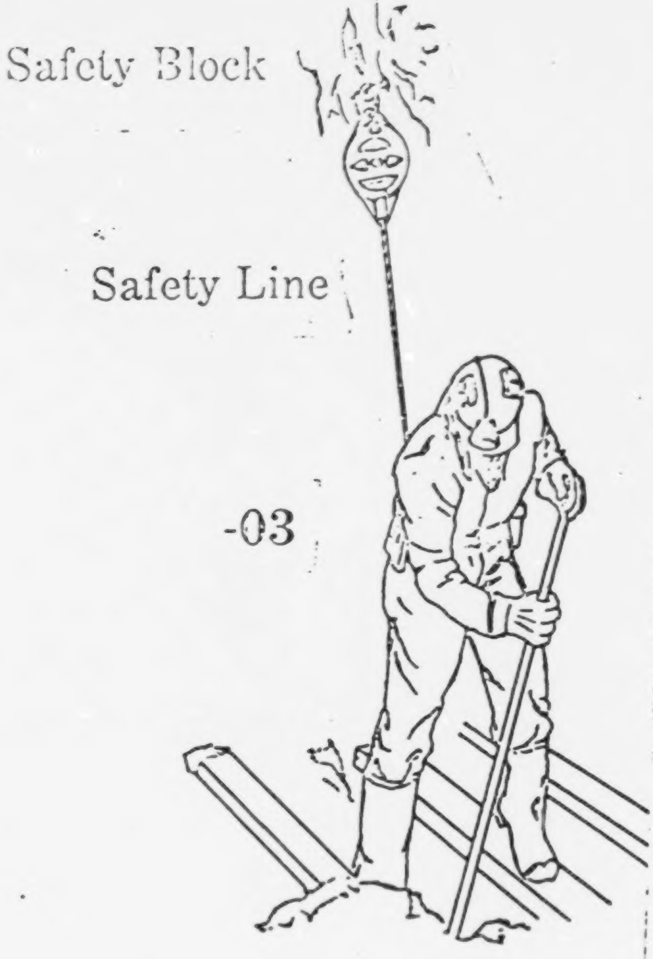


Moil Controls



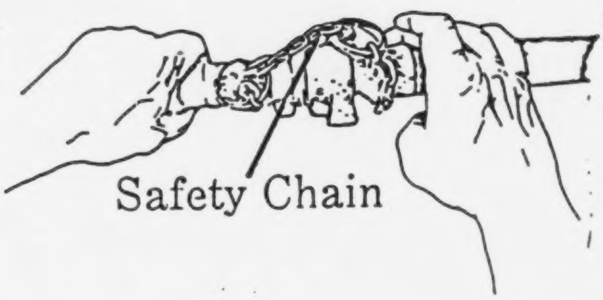
Chain Saw Controls

-03

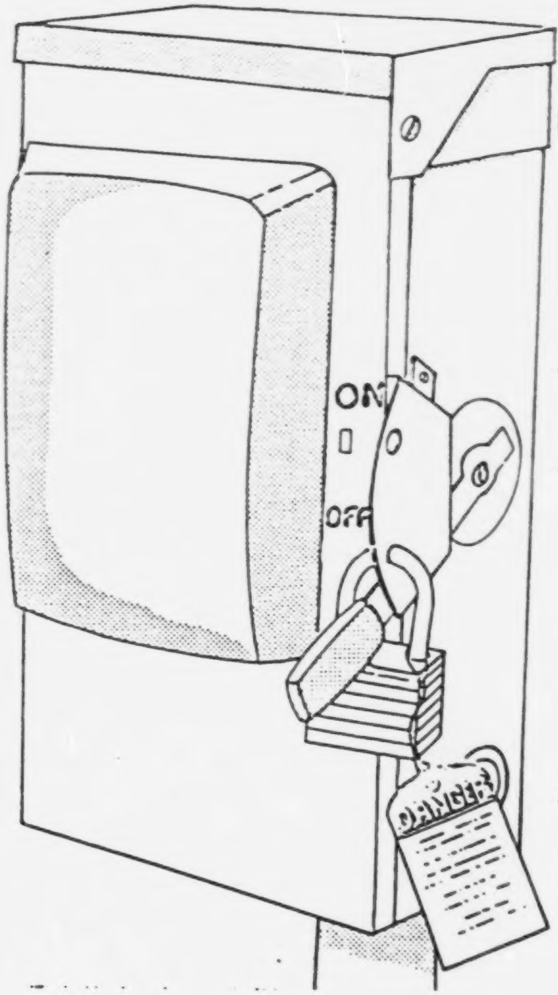

Safety Block
Safety Line

Airlines or other pressurized lines (flexible air lines) shall be secured by safety chains.

-04


Safety Chain

Lock & Tag Procedure


ON
OFF
DANGER

-05

PROCEDURE SHEET FOR SAFE BARRING DOWN PRACTICE

Definition:

Logical Step	- Any step that advances the operation forward.
Operational Hint	- This is any useful hint that may be used to make the logical step easier or to help break the operation.
Safety Hint	- This is any safe operating practice that should be followed at this particular step.
Tight Loose	- This is rock that is too tight to fall easily but is too loose to remain safely.
Back	- This is the term used to define the roof.

This procedure assumes a continuing stope operation. It begins immediately after blasting procedures.

Logical Step	Operating Hints	Safety Hints
1. Wet down stope area from the raise out to blast face.	Lay water hose on muck pile to thoroughly wet down and suppress dust.	Clean down and blast debris from overhead timber in stope.
2. Stay under timber and test back immediately in front of the bulkhead.	(1) Use only proper tools. (2) Short scaling bar; long scaling bar.	Do not expose any part of your body on the timber while testing for tight loose.
3. Bar down any tight loose in front of the bulkhead.	Note: This will give the miner a safe area to proceed in front of timber.	(1) Do not pry forward with the scaling bar. (2) This will present the danger of falling beneath the rock you are barring down. (3) Do not place bar immediately in front of you. If a slab should come down onto the bar the bar may go through you.
4. Proceed in front of timber through the bulkhead.		

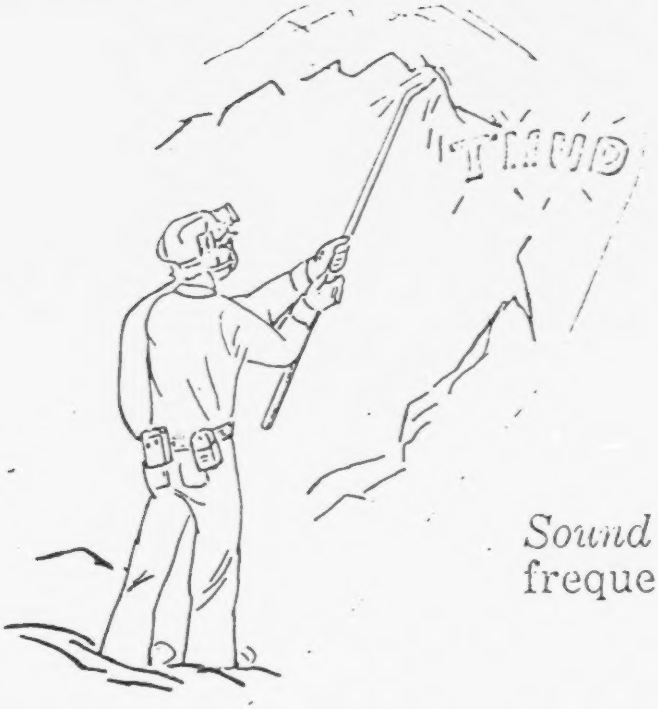
Logical Step	Operating Hints	Safety Hints
5. Test the back immediately to your left.	(1) Test back by sounding the bar against the back. (2) If a ringing noise is heard, the back is safe. (3) If a "drummy" noise is heard, the back must be inspected closely for cracks.	Tight loose emits the drummy sound.
6. Work your way over to the left wall.	Note: Inspect back carefully then proceed to the right wall.	This gives you the benefit of the wall for support.
7. Test back near right wall.	Repeat test for drummy ground.	
8. Bar down tight loose.	Note: Barring down is a continuing process. The nature of blasted rock is such that it continually develops new cracks in it.	

Summary:

1. Barring down with a long bar is essentially the same procedure as a short bar. Care must be used in the selection of a proper tool for barring down. Never bar down with the bar directly in front of you. This bar could go through you if a large enough slab comes down.

2. Check back to see if the loose may be keyed to the rock on the side. Caution: The slab on the side may fall when the slab is barred out of the back.

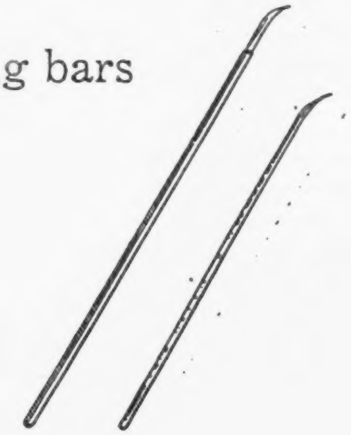
3. If the slab cannot be barred down, it must be blasted down or temporarily supported.



-02

Sound the back frequently.

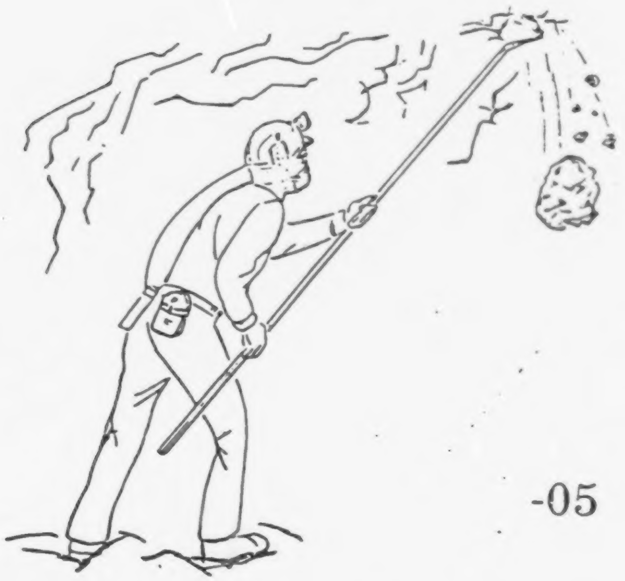
Scaling bars



-03

Bar should be of proper length and blunt at one end.

Do Not expose your body to dangerous rock conditions by proceeding into unbarred areas.



-05

PROCEDURE SHEET FOR SAFE TIMBERING PRACTICE

IN A METHOD OF TIMBERING

Definition:

Logical Step -	Any step that advances the operation forward.
Operational Hint -	This is any useful hint that may be used to make the logical step easier or to help break the operation.
Safety Hint -	This is any safe operating practice that should be practiced at this particular step.

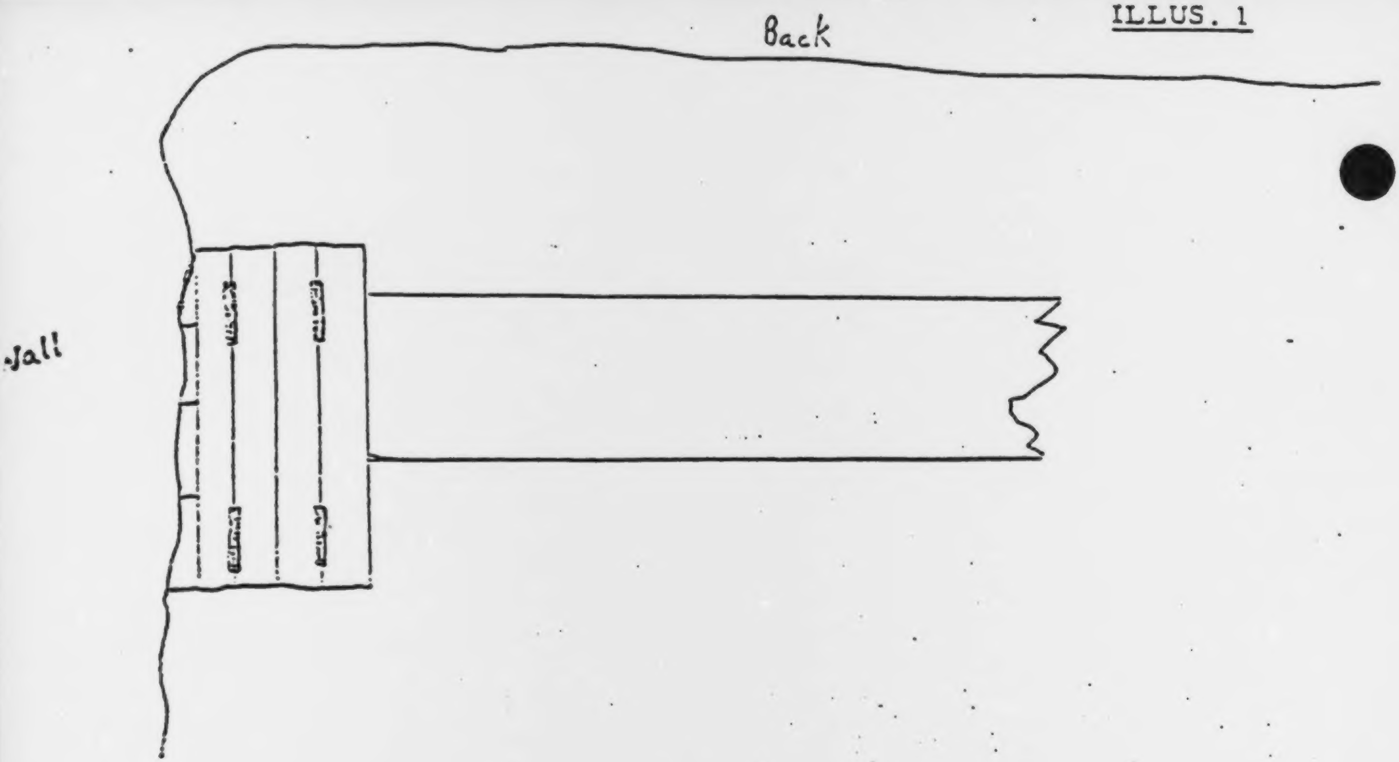
This procedure sheet assumes a continuing stoping operation. This procedure begins after the initial leveling procedure has taken place.

Logical Step	Operating Hints	Safety Hints
1. Miner must have muckpile leveled out before timber can be installed. (Note: See slushing procedure)	Alternative positions of sheave block across the three eye bolts will level out muckpile.	Follow safe barring down procedures. (Note: See barring down procedure)
2. Measure for cap wall to wall.	Allow 12" per side for heading.	
3. Send timber order to nipper.	Timber order must be in a sequential order: 1. Cap 2. Lagging 3. Headboards 4. Wedges 5. Posts	This allows you to get the timber order to the face in the order of use.
4. Take tail cable off slusher bucket.	Leave tail sheave block in center eye bolt at face.	Use gloves when handling cable.
5. Lay out tail cable to raise.		
6. Land cap in raise.		Open safety door.

Logical Step	Operating Hints	Safety Hints
7. Put tail cable around cap and secure.		
8. Pull cap up into stope.	Slide cap around end of slusher, if possible (use slusher power).	Close safety doors.
9. Pull cap back to work face.	Pull cap against face.	
10. Put cable in the middle of the cap.	Pull cap across muckpile in approximate position for heading in.	
11. Nail 6' tie lagging from center to center on previous cap up to new cap.	Use headboards on muckpile to raise cap to desired position.	Inspect back to see if it needs barring down.
12. Level cap according to previous cap.	40p nails -- Use headboards for leveling.	Nailed tie lagging prevent cap from rolling down the muckpile.
13. Take cable off the cap and pull the end back to the raise.		
14. Open gate on timber slide.		Be sure to stand where you will not fall down raise. Check for tripping hazards.
15. Unload lagging. Return skip.	1) Stack lagging in a stack, eight high and two wide. 2) Wrap cable around the lagging and secure.	Close raise door.
16. Pull lagging back to work face.	Repeat process until lagging order is at the face.	
17. Unload headboards.	1) Stack headboards in a stack eight high and two wide. 2) Wrap cable around center of headboard and secure.	Close raise door.

Logical Step	Operating Hints	Safety Hints
. Pull headboards to work face.		Check back for "tight loose".
19. Field fit cap to walls and wedge cap in (See illus. 1 for procedures)		Observe safe rules for using axes in timbering.
20. Install girts.	1) Cut girt on a slight bias to wedge it between caps. 2) Secure with two 60p nails on each end.	
21. Install floor on caps.	1) Leave 5' section open in middle of caps. 2) Floor out to the walls and chink walls with filler pieces of headboard.	
22. Put two lagging down on edge of 5' opening.	Repeat on both sides of 5' opening.	
23. Put 3 headboards on one end of lagging and 3 headboards on the other end.	Repeat on the other bulkhead leg.	
24. Put 3 lagging on top of headboards.	Repeat on other side.	
25. Slide 3 lagging across top of bulkhead legs to back of bulkhead.		
26. Field fit up to the back on top of the floor.	Put at least 4 sq. ft. of headboard on each corner of bulkhead (See illus. 2) for design.	
27. Slide 3 more lagging onto top of bulkhead legs.	This completes the floor to the front of the cap.	
28. Field fit to back of the ore.	(See Illus. 2 for design).	

ILLUS. 1



1. Select 12" headboard.

2. Measure down 3" from top of headboard.

3. Drive two nails in headboard. One on each side of centerline approximately 4" apart.

4. Hang headboard over end of cap.

5. Drive two nails into the end of the second headboard.

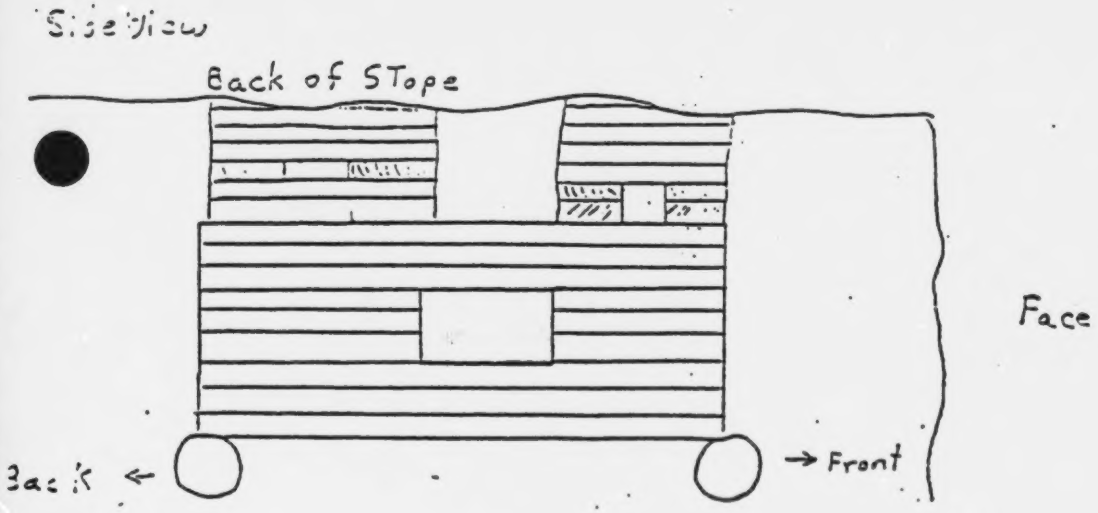
6. Hang second headboard over the first board.

7. Repeat this process until wall is reached.

8. Fill in cracks with small pieces of headboard.

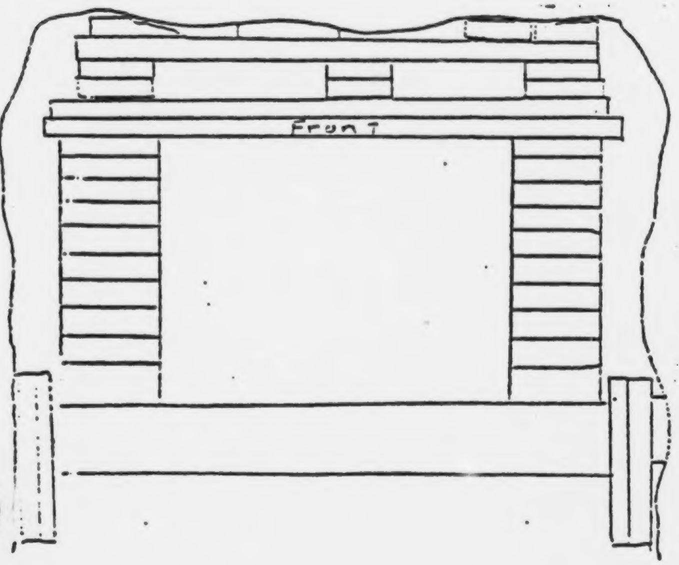
9. Repeat on opposite end.

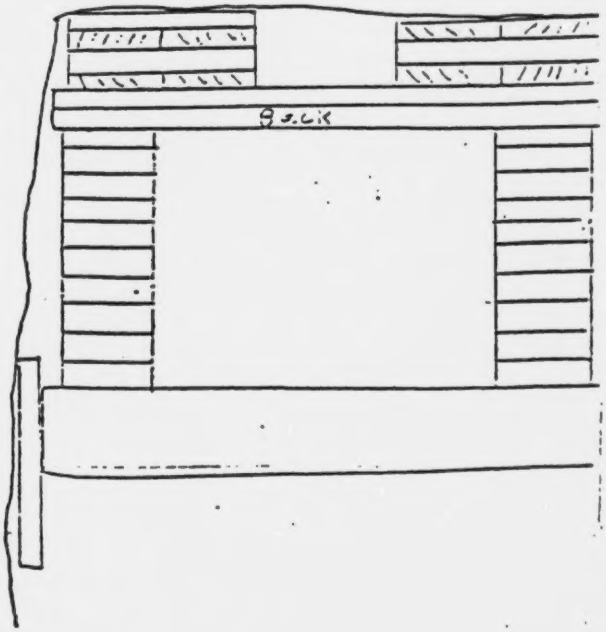
10. Wedge cap in securely. (Check illustration above for position of wedges.)


Side View
Back of STope
Face
Back ←
→ Front

After installing bulkhead floor, the miner will place headboard cribs on each of the back corners. This will yield 4 sq. ft. of roof support for each corner.

On the front of the bulkhead floor, the miner will place headboards on the front corners and in the middle of the bulkhead. Next, the miner places 2 lagging on the headboards to tie them together, then field fits to the back.

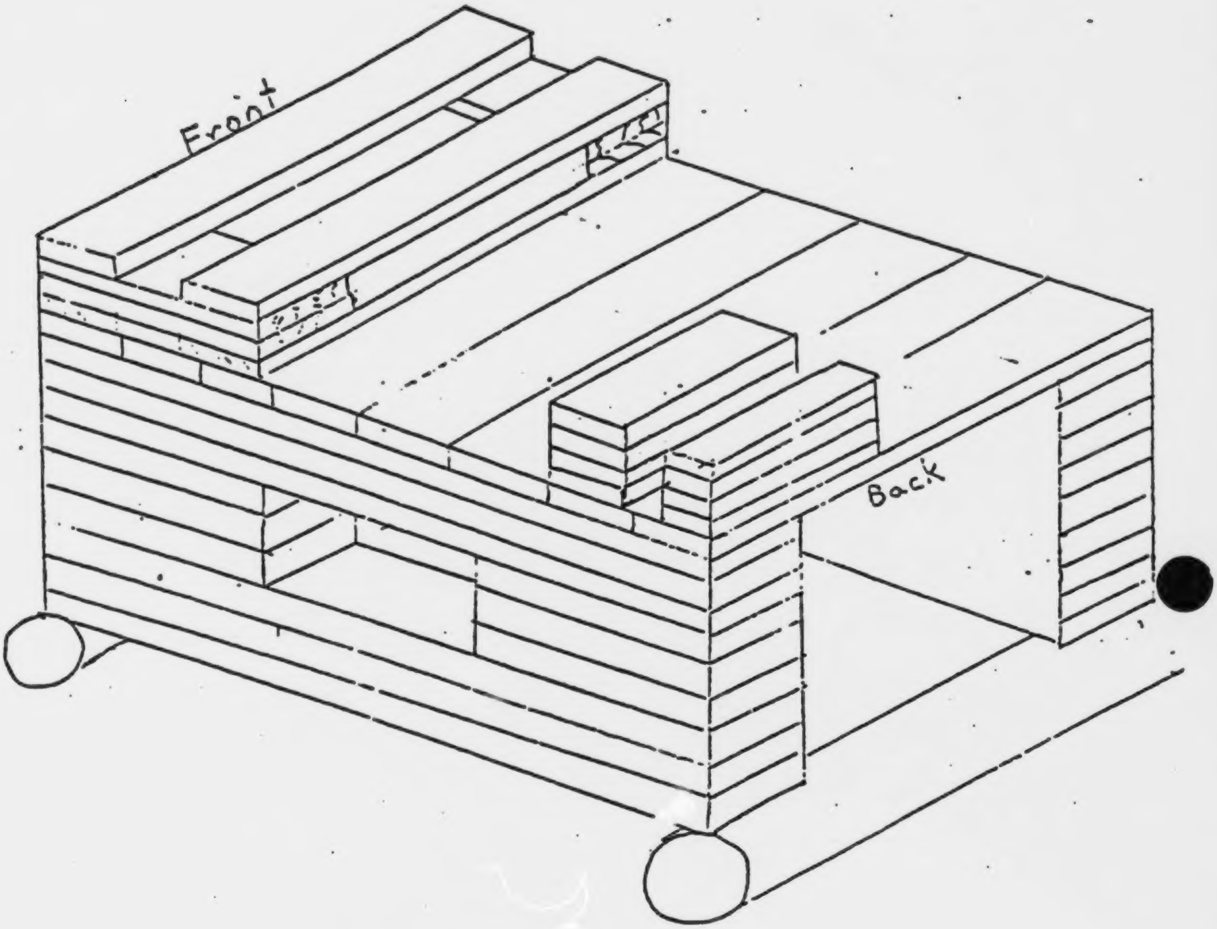




ILLUS. 3

STAR BULKHEAD

(Isometric View)

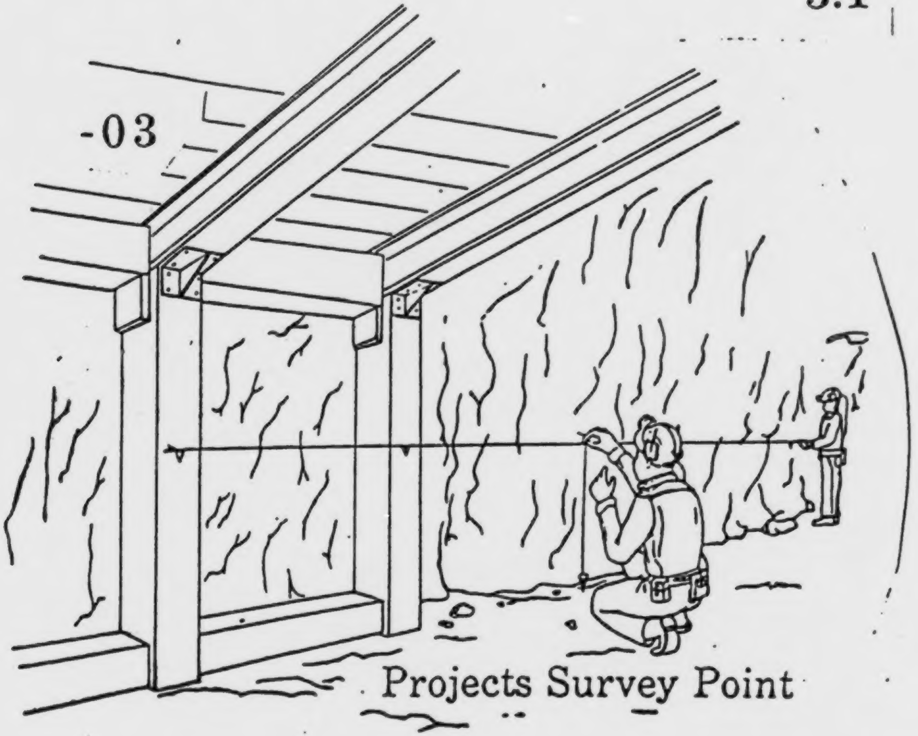


Bulkhead Design:

This design calls for 27" of bulkhead height. The basic design calls for:

1. 3 lagging.
2. 3 headboards on each end of bulkhead
3. 3 lagging
4. Bulkhead floor cover
5. 4 sq. ft. on each back corner
6. 12 sq. ft. on front leading edge

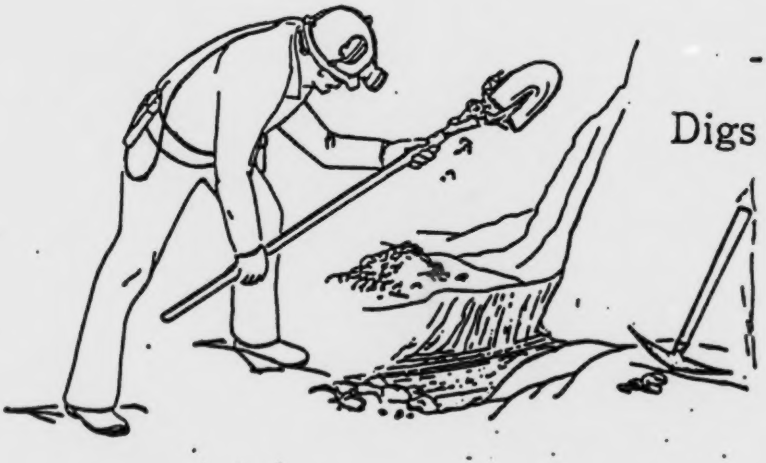
-03



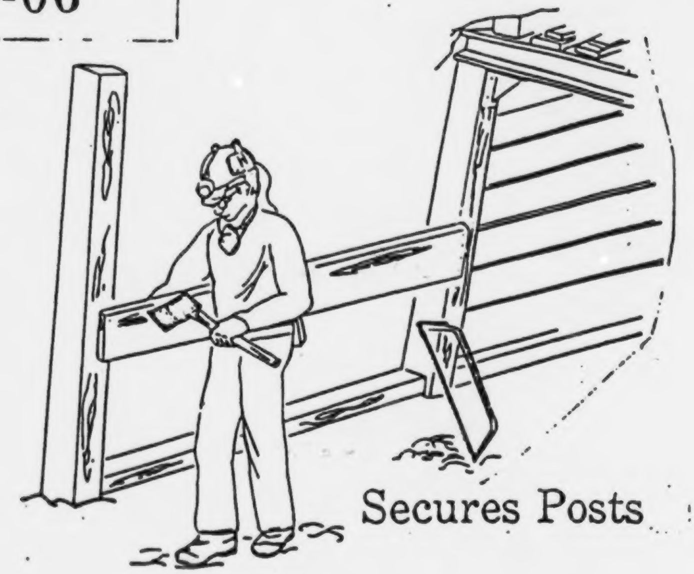
Projects Survey Point

-04

Digs Hitch

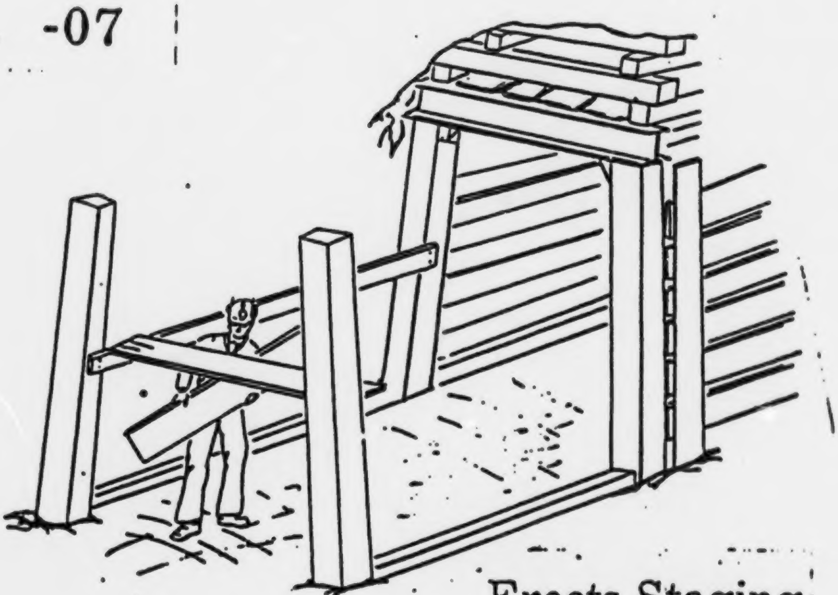


-06

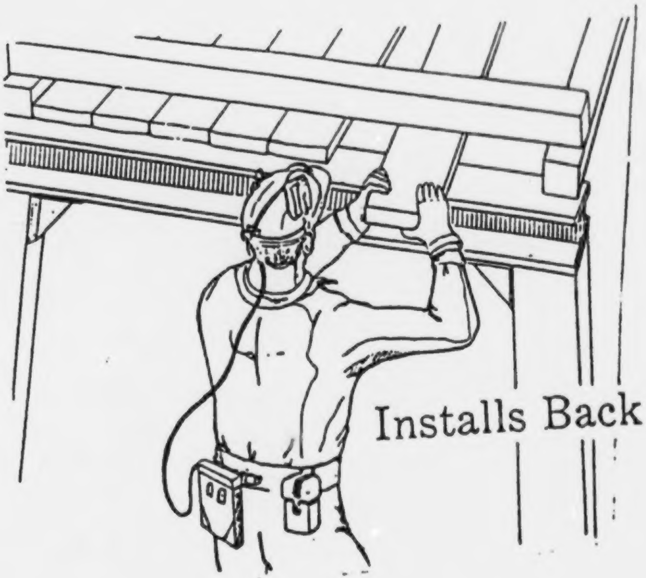


Secures Posts

-07

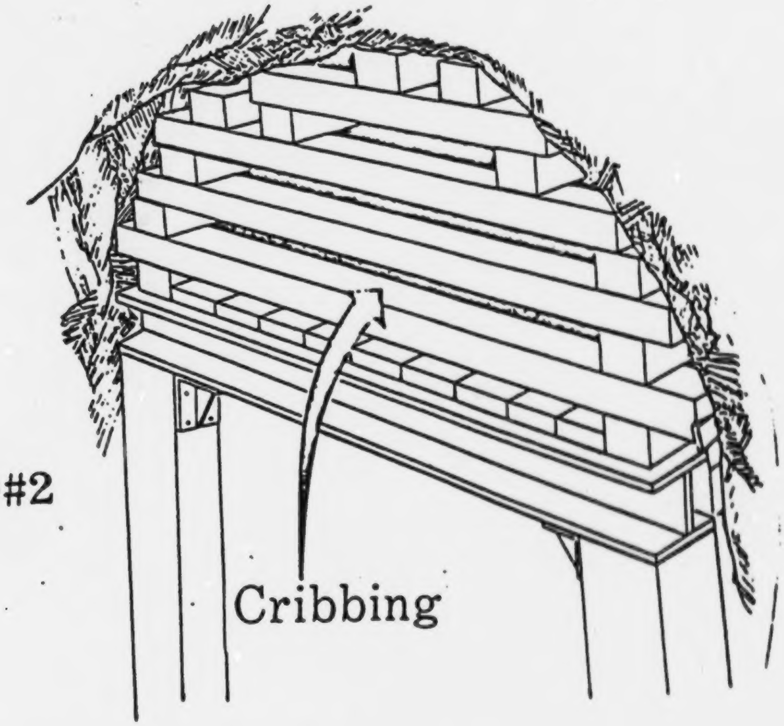


Erects Staging



-09#1

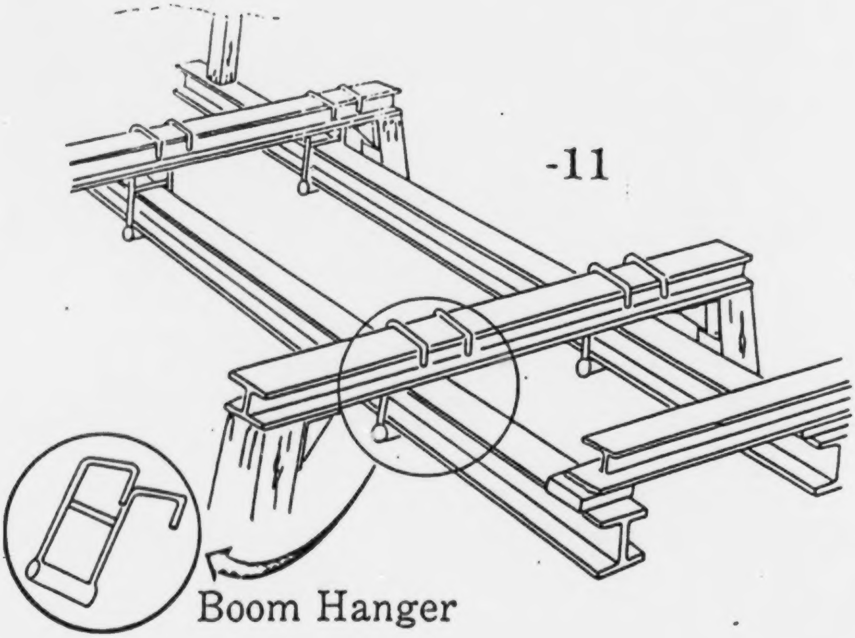
Installs Back Lagging



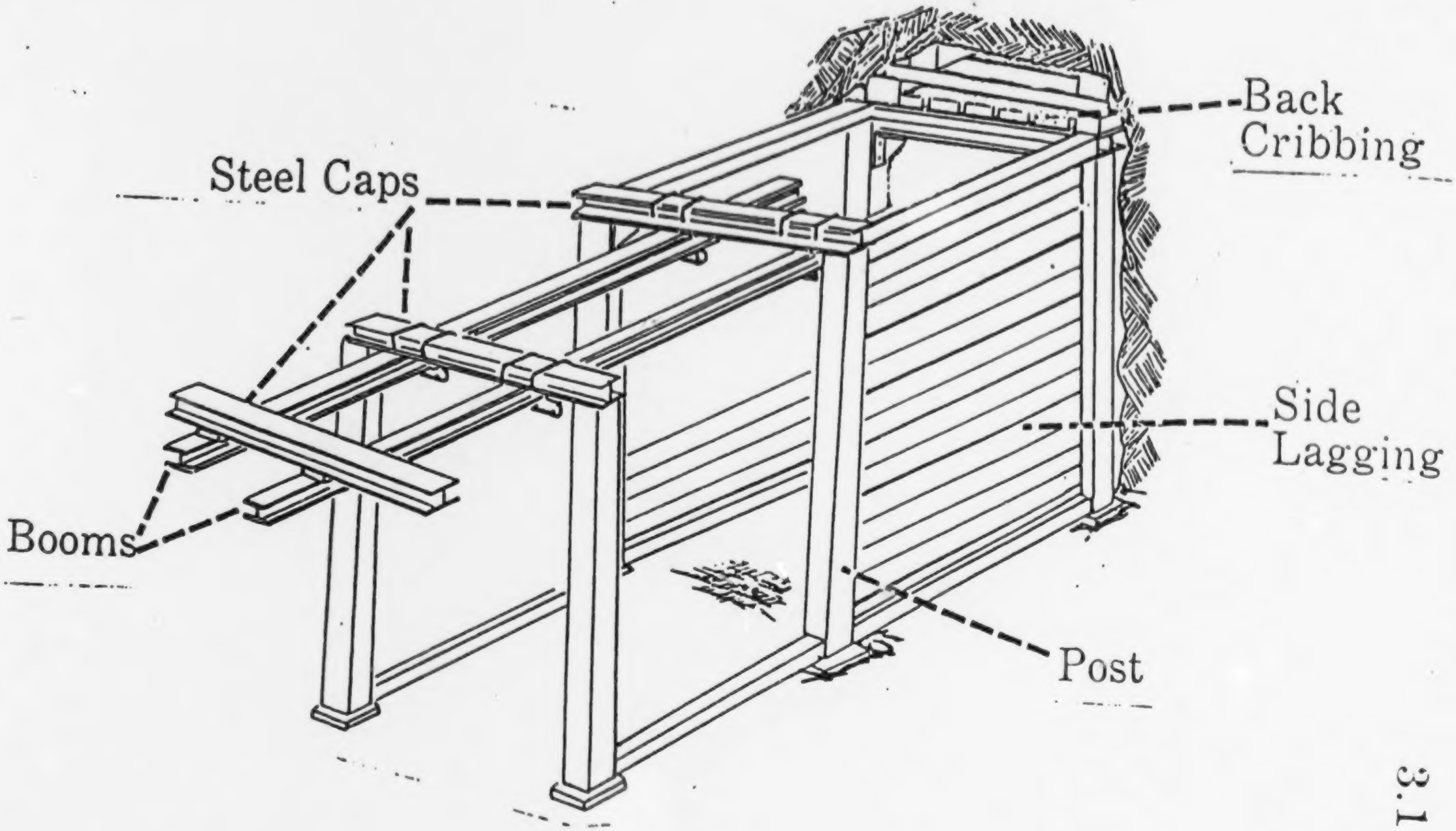
-09#2

3.1

-11

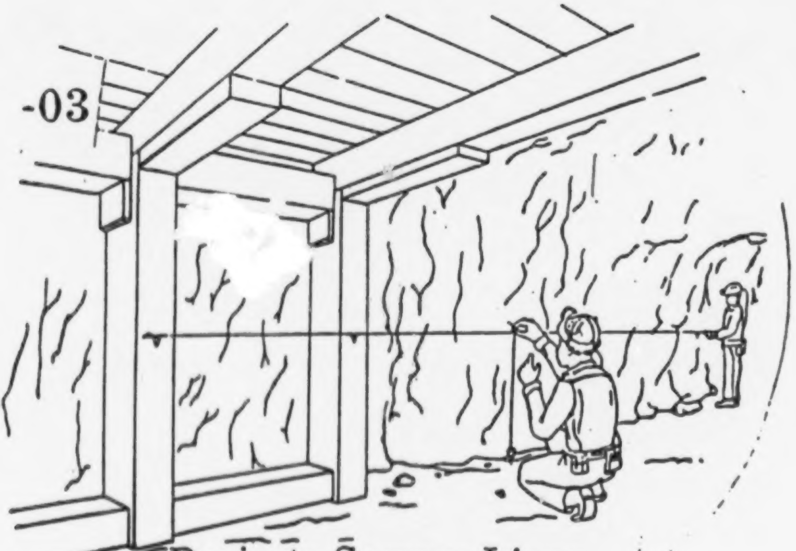

Boom Hanger

Installation of Booms


Steel Caps
Back Cribbing
Side Lagging
Booms
Post

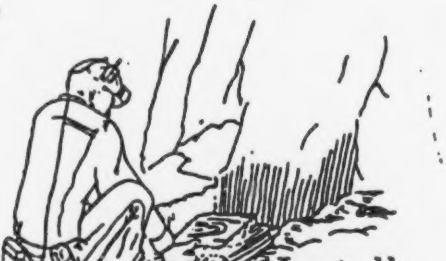
3.1

-03



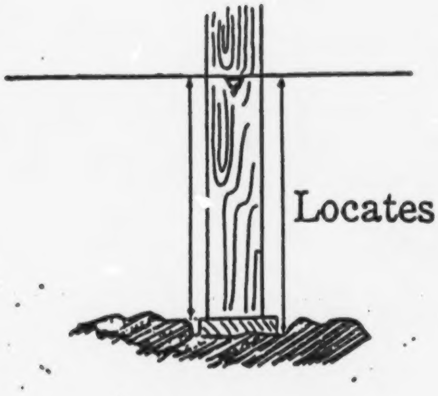
Projects Survey Lines

-05



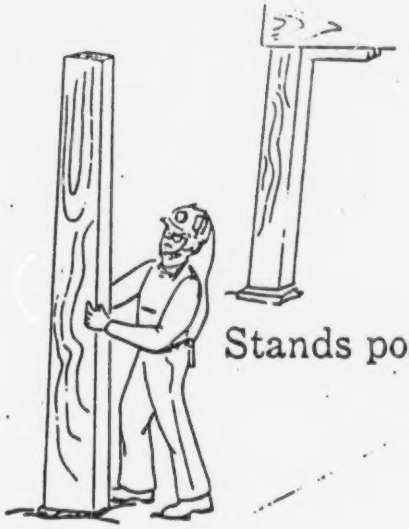
Installs
Foot boards

-06



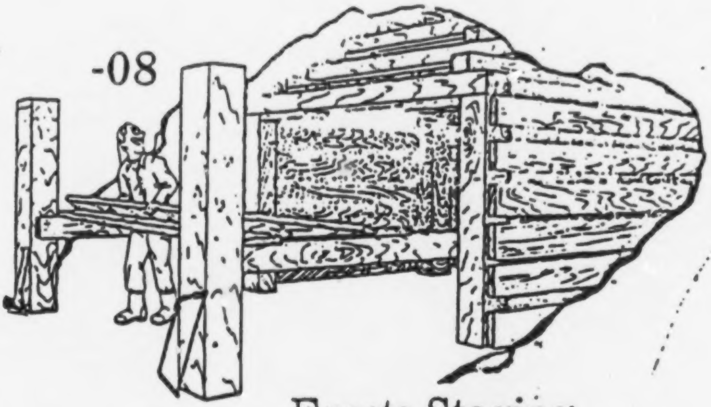
Locates Grade Point

-07



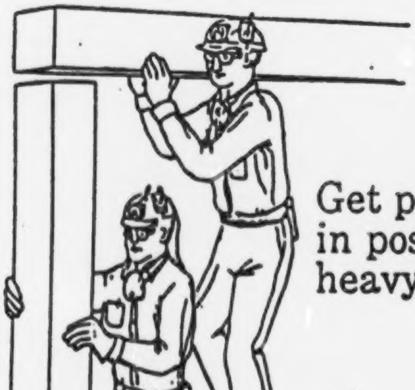
Stands posts

-08



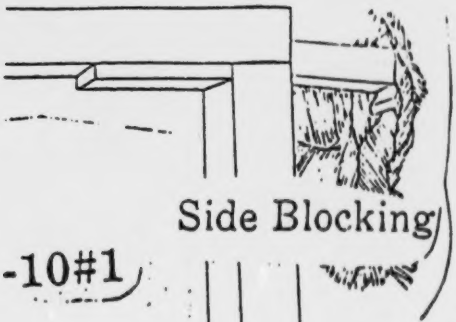
Erects Staging

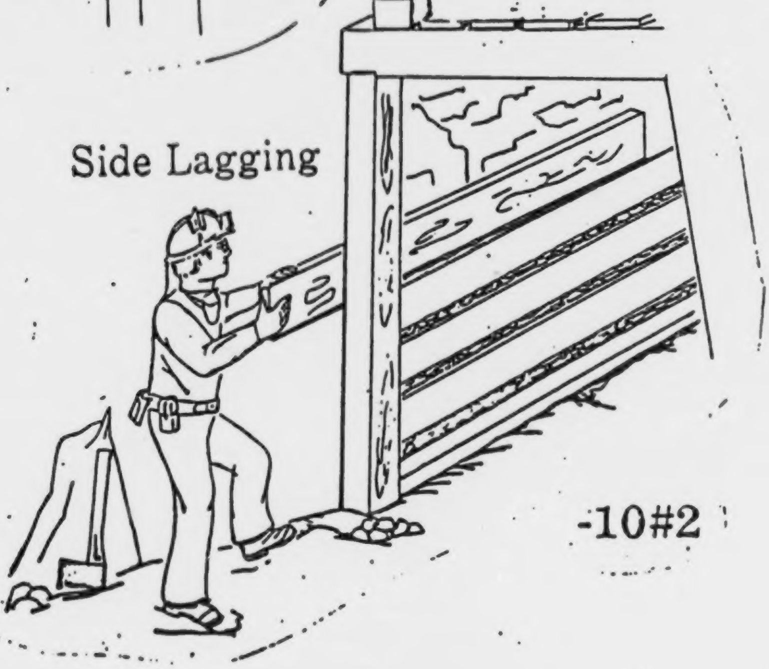
-09



Get partner's help in positioning heavy timbers.

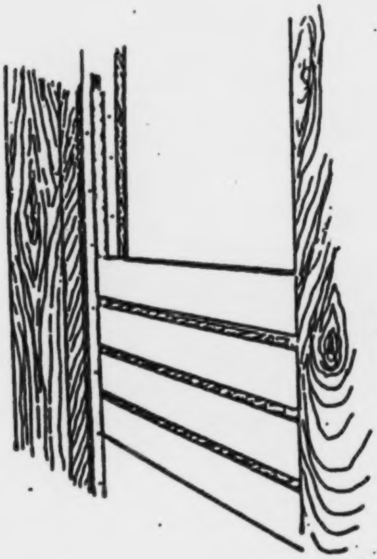
-10#1


Side Blocking


Side Lagging

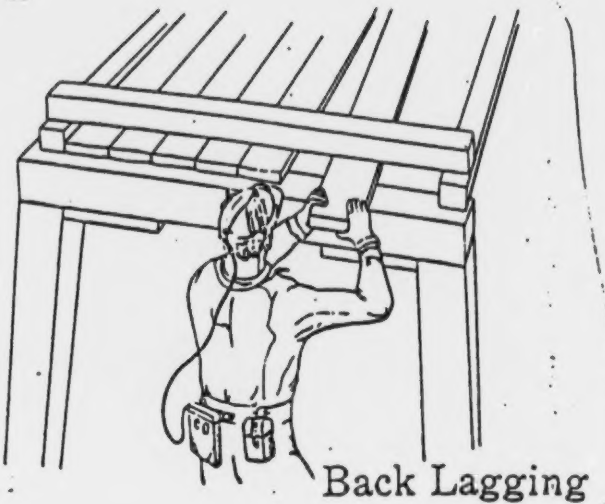
-10#2

-10#3

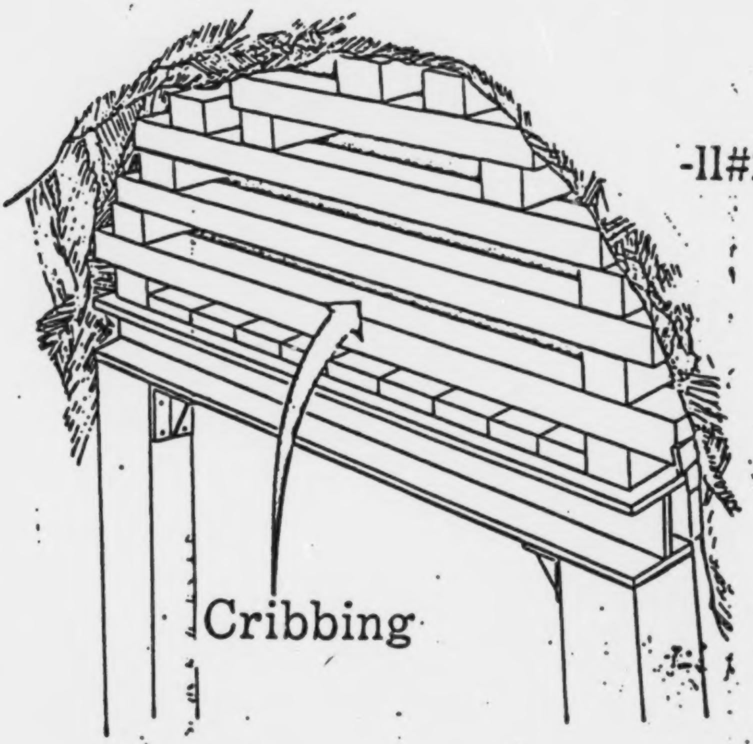


Coeur D' alene
lagging

-11#1

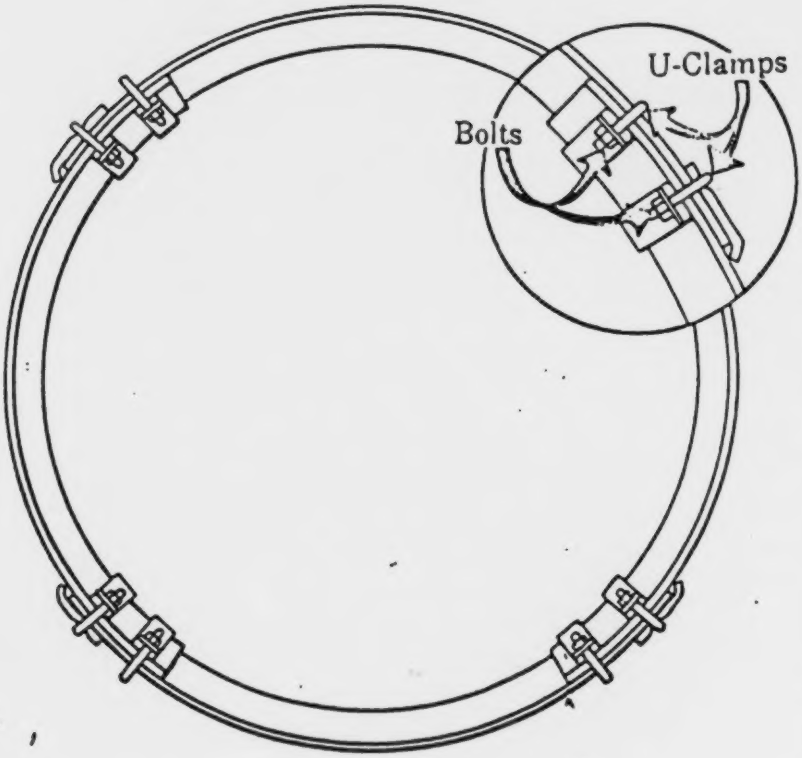

Back Lagging

-11#2



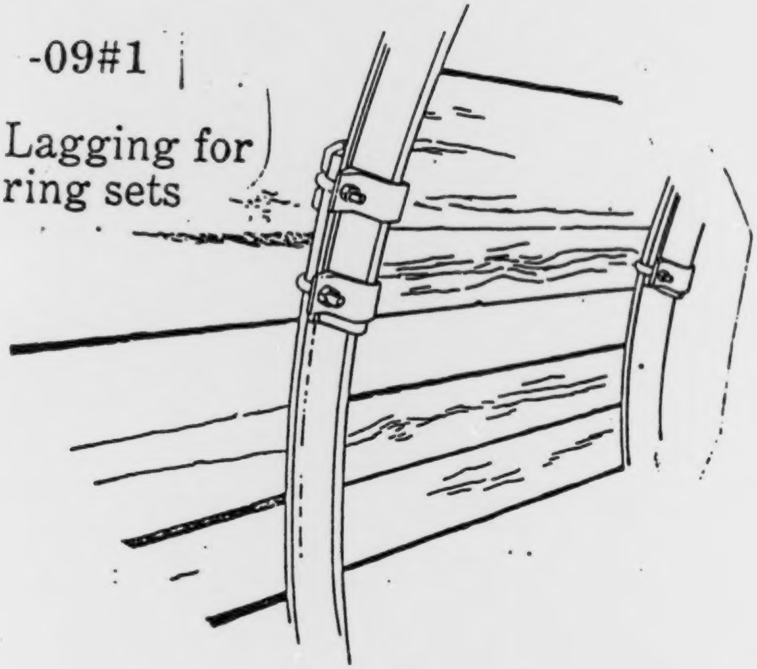
-06

YIELDABLE MINE ARCH


U-Clamps
Bolts

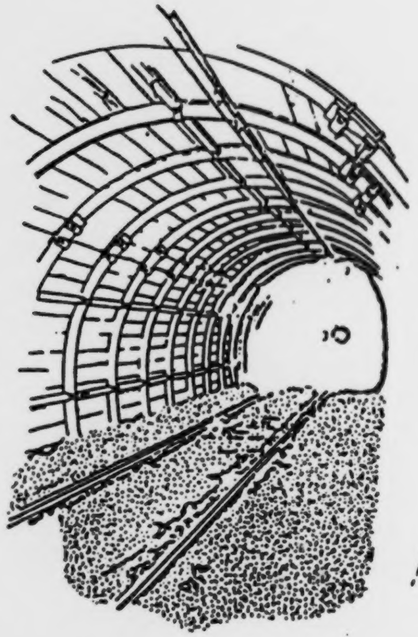
-09#1

Lagging for ring sets



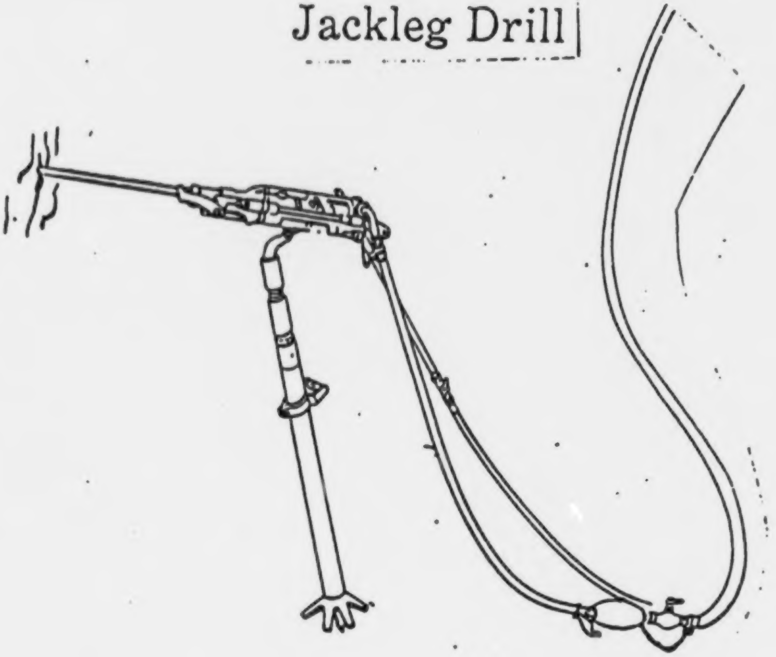
-09#2

Series of ring sets with lagging in place

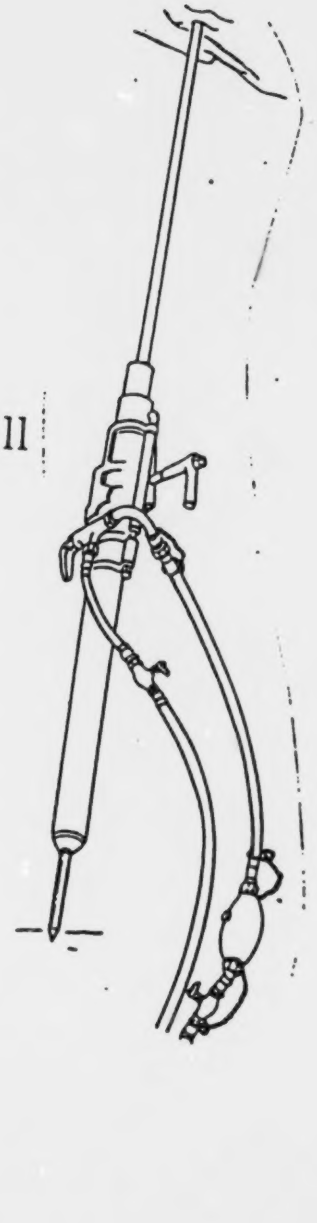


-03#1

Jackleg Drill

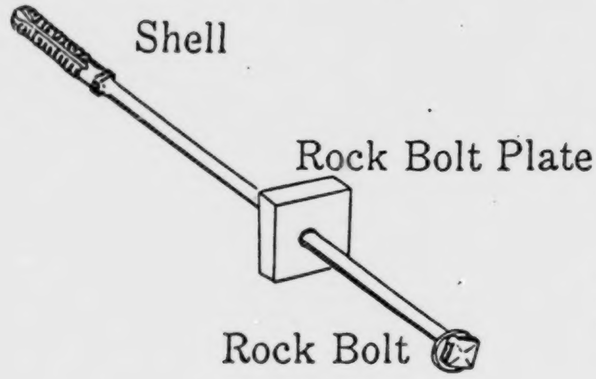


-03#2



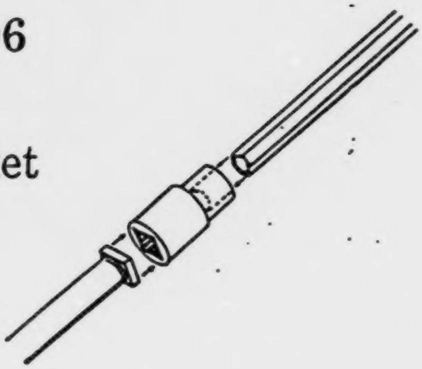
Stoper Drill

-04


Shell
Rock Bolt Plate
Rock Bolt

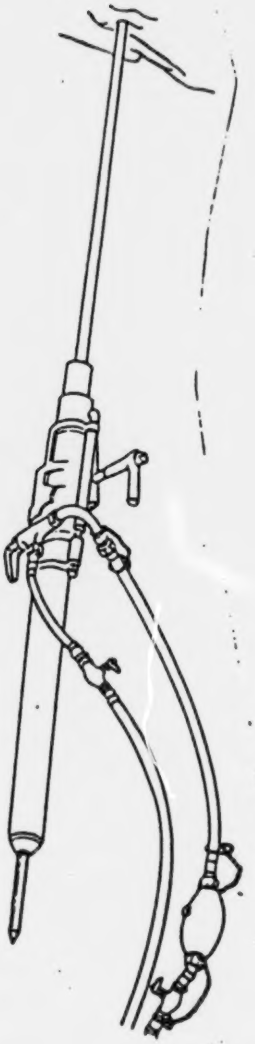
-06

Rock bolt socket
and steel

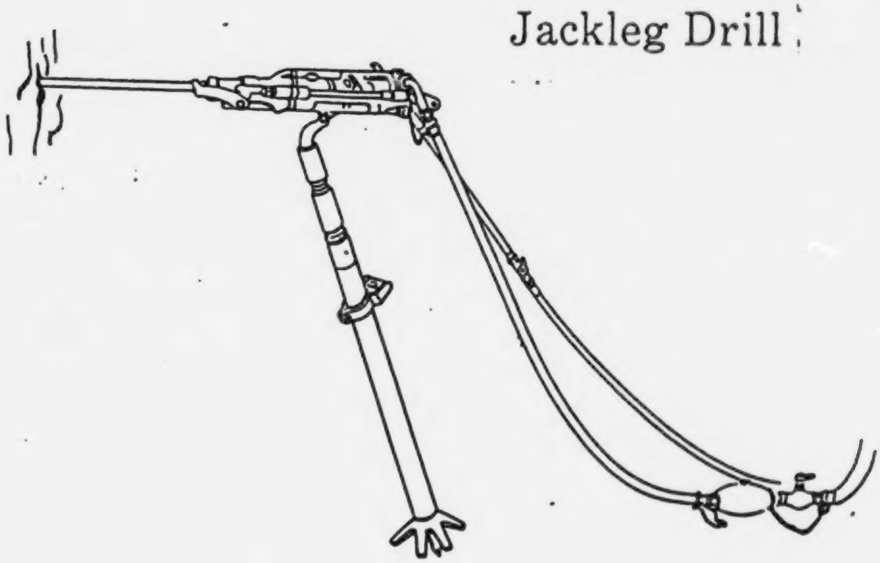


-03#1

Stoper Drill

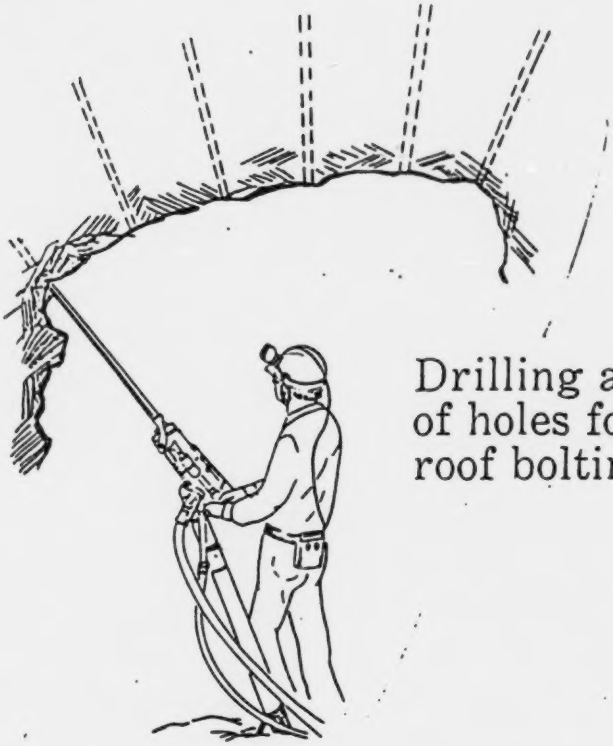


-03#2



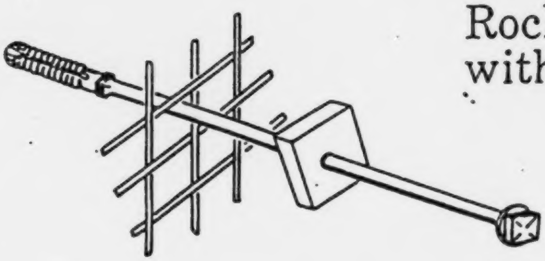
Jackleg Drill

-05

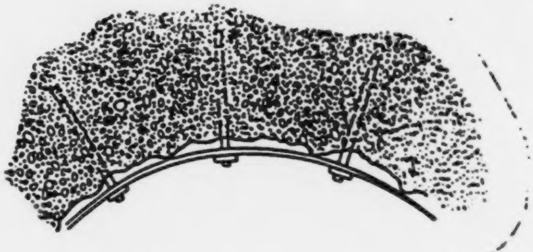


Drilling a round of holes for roof bolting

-06

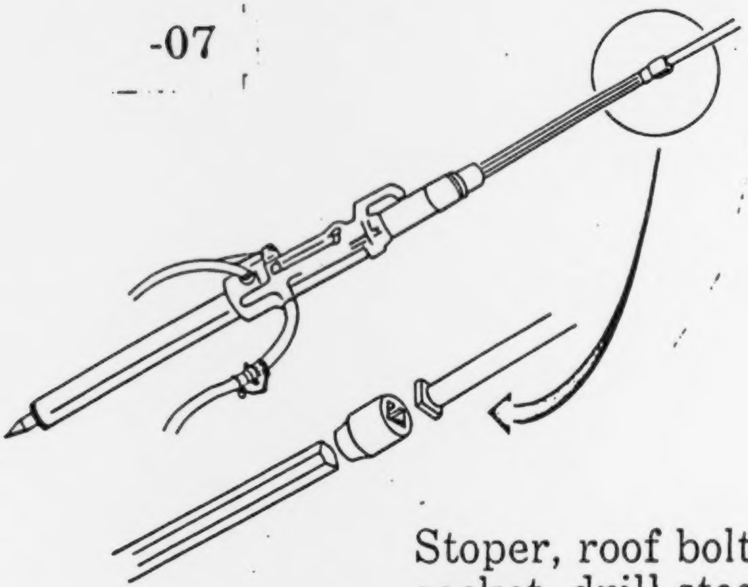


Rock bolt with fencing



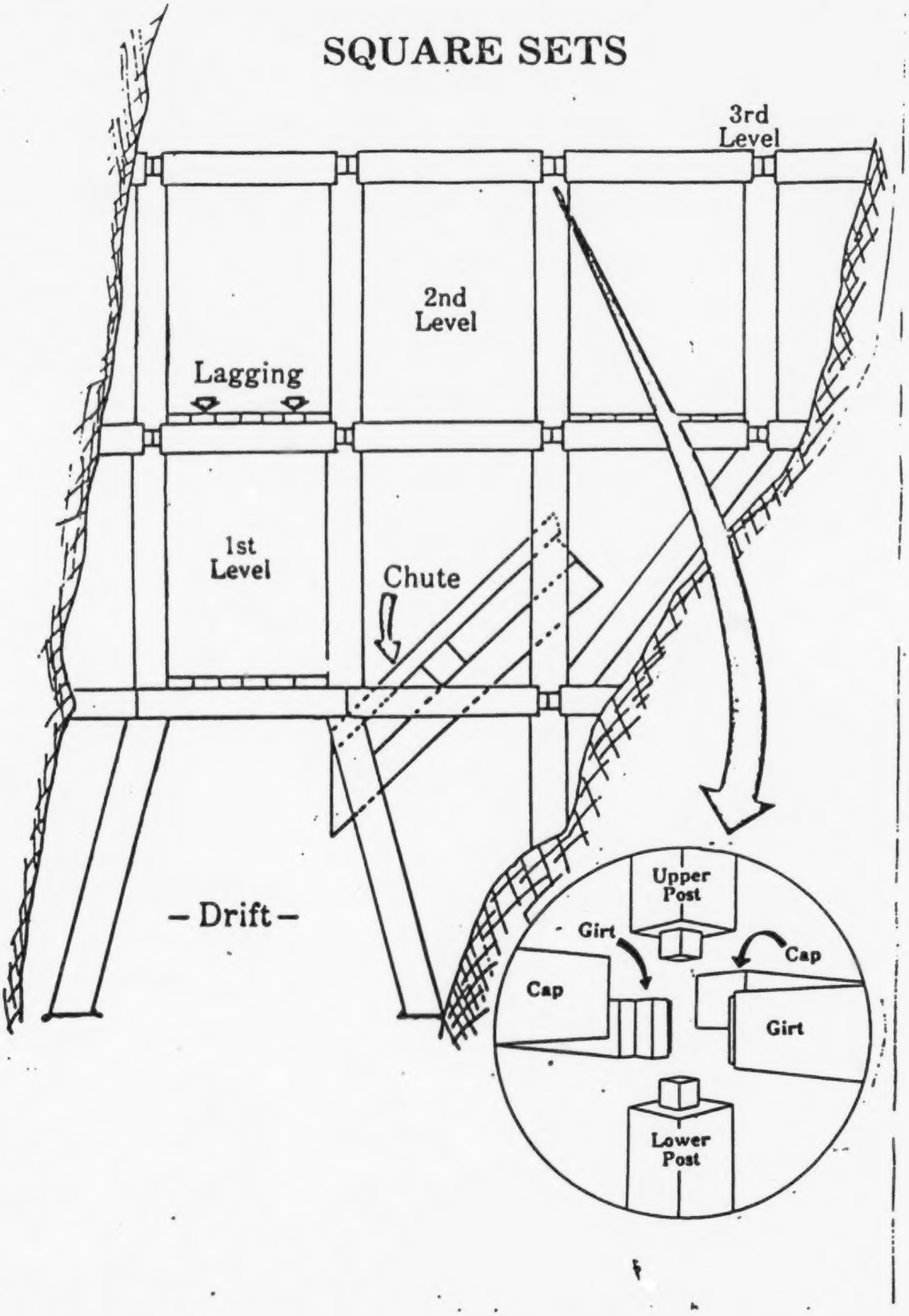
Rock bolts in strata

-07

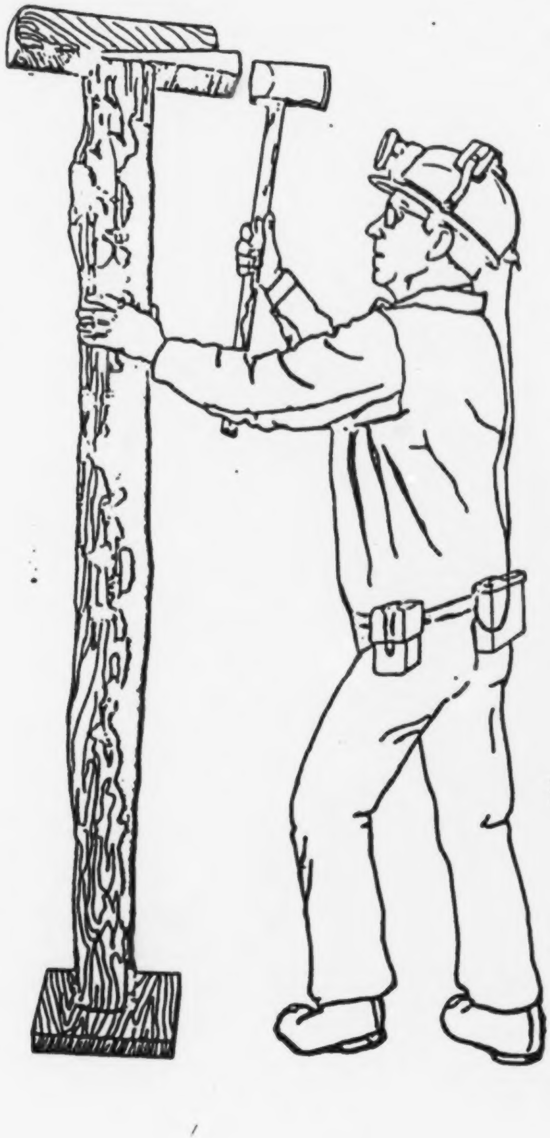


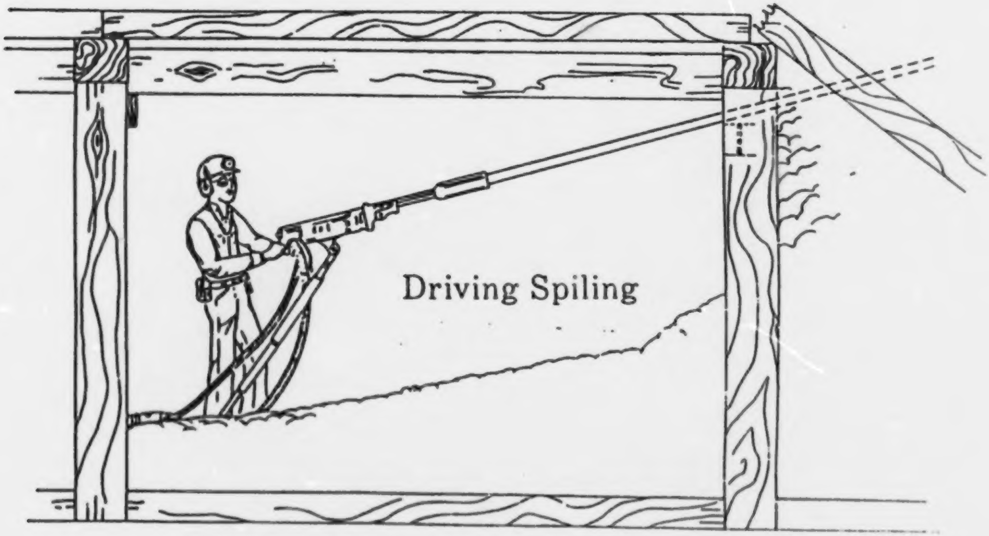
Stoper, roof bolt socket, drill steel, roof bolt

SQUARE SETS

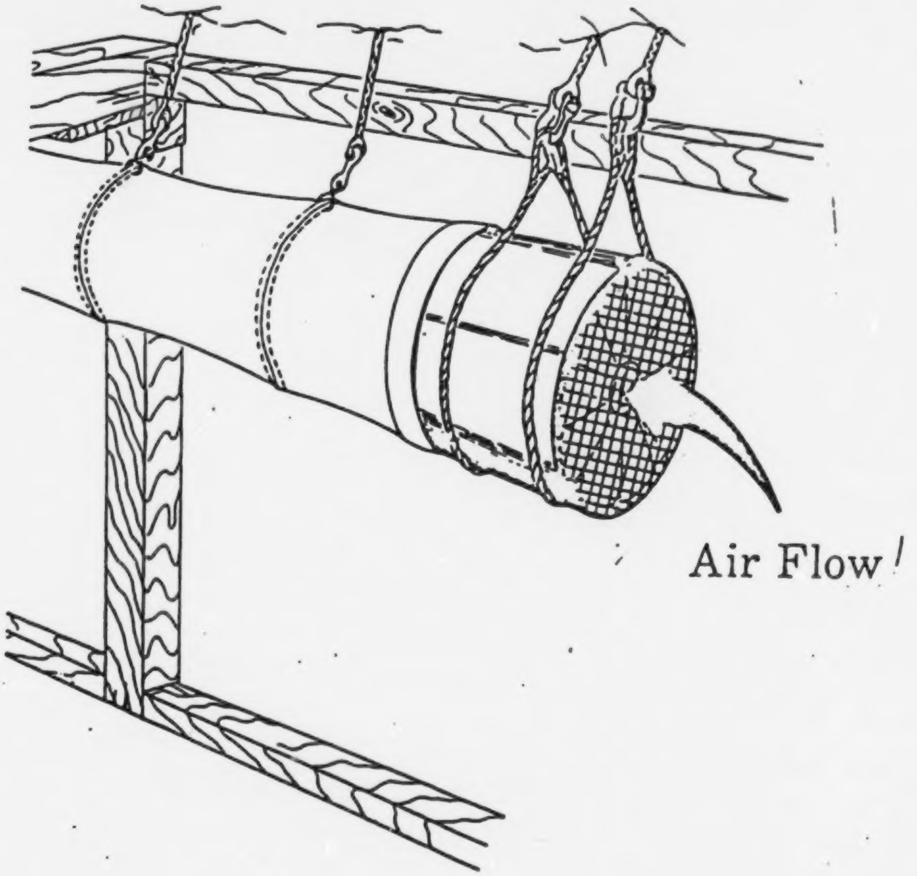

3rd
Level
2nd
Level
Lagging
1st
Level
Chute
- Drift -
Upper
Post
Girt
Cap
Cap
Girt
Lower
Post

Installing Single Timber Support (Stull)

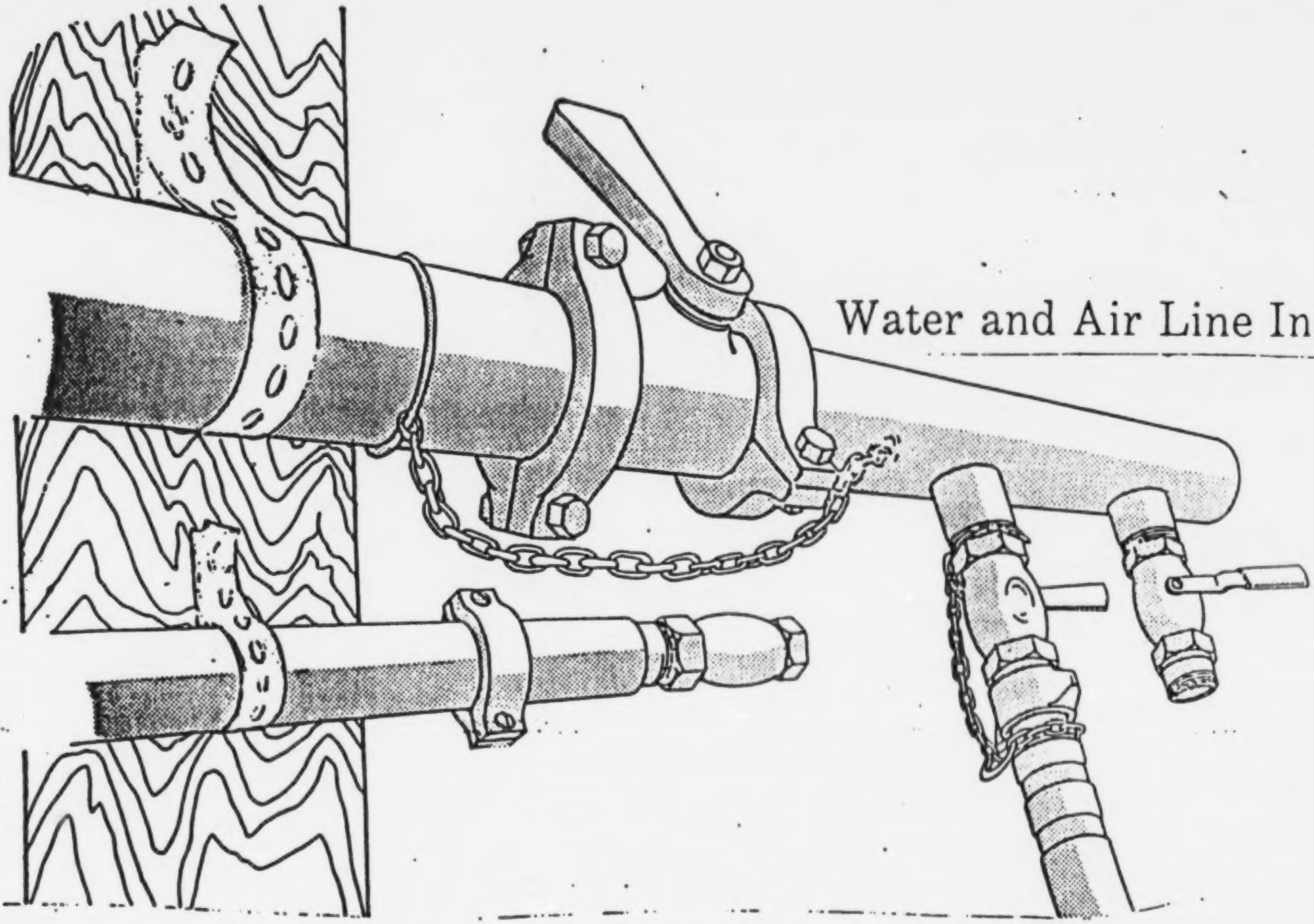



Driving Spiling

Ventilation (Electric Fan) Installation



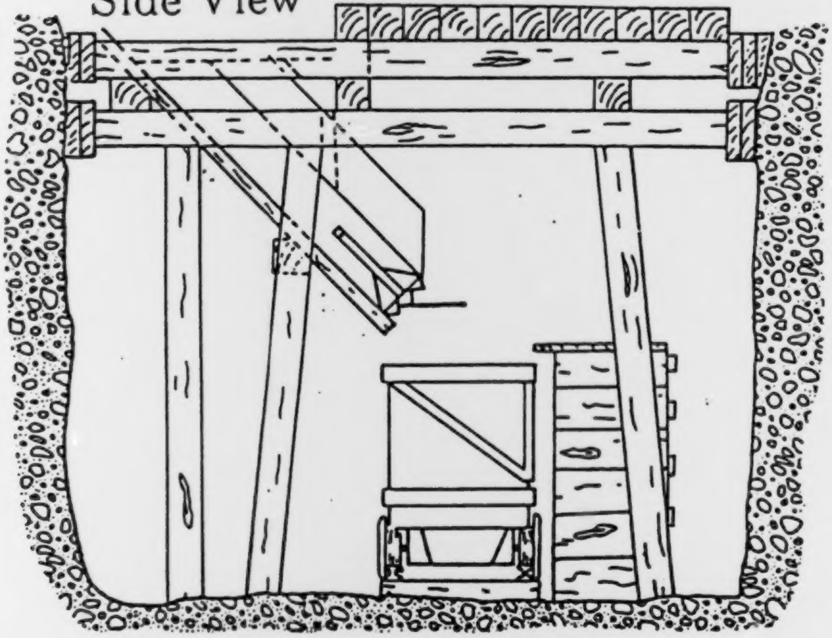
Water and Air Line Installatio



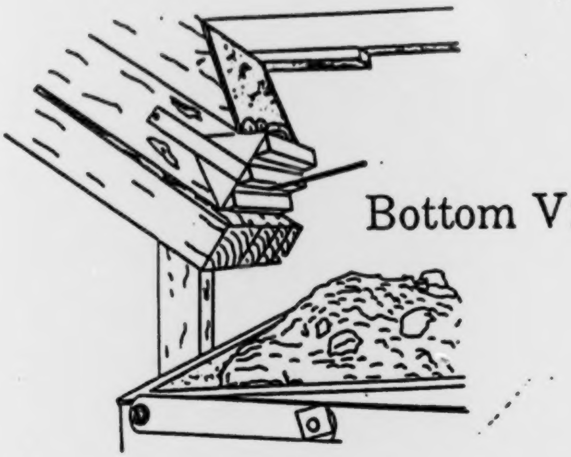
4.2

4.3

Chute Installation

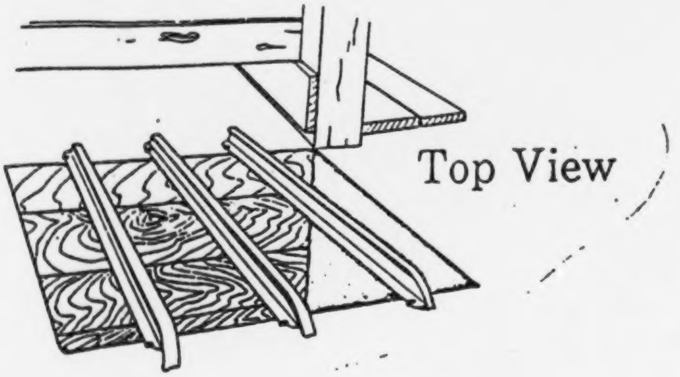


Side View

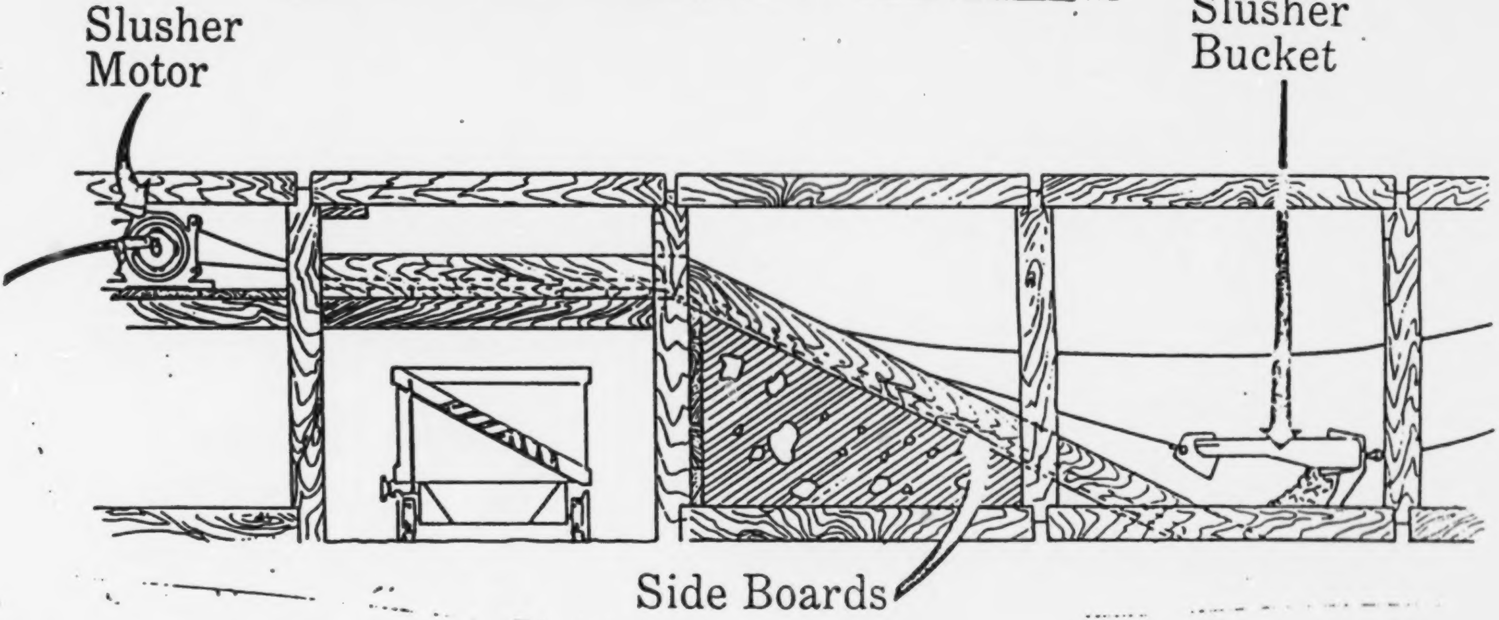


Bottom View

Chute Installation

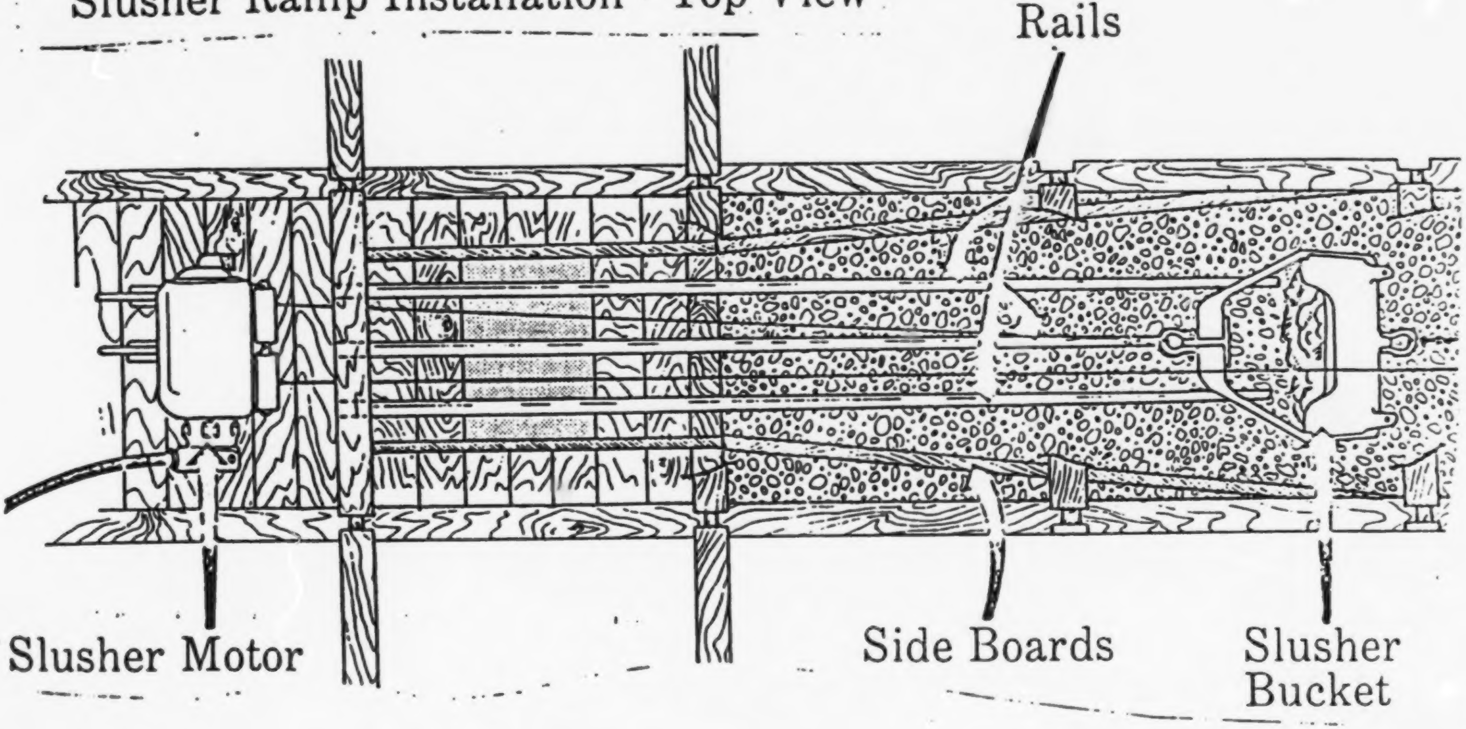


Slusher Ramp Installation - Side View


Slusher Motor
Slusher Bucket
Side Boards

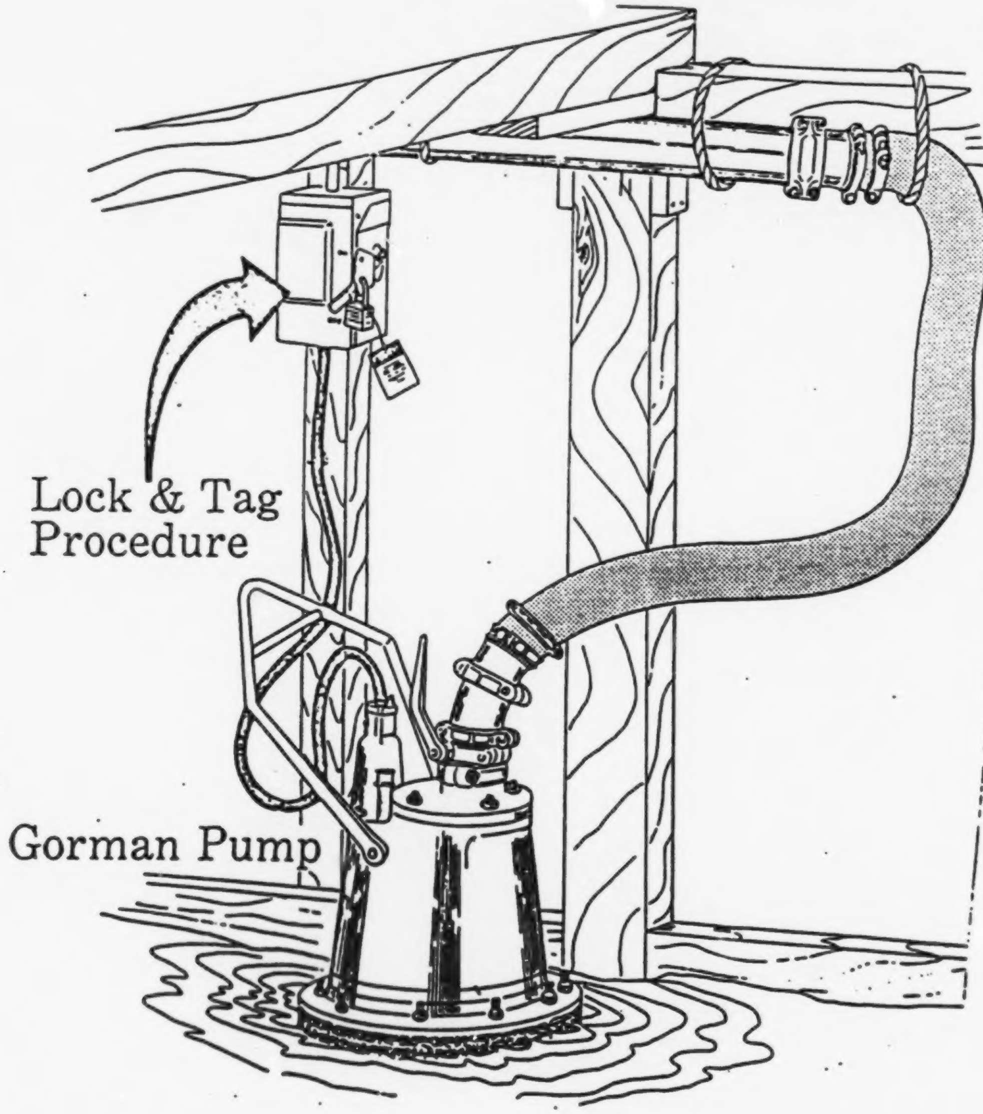
4.4

Slusher Ramp Installation - Top View

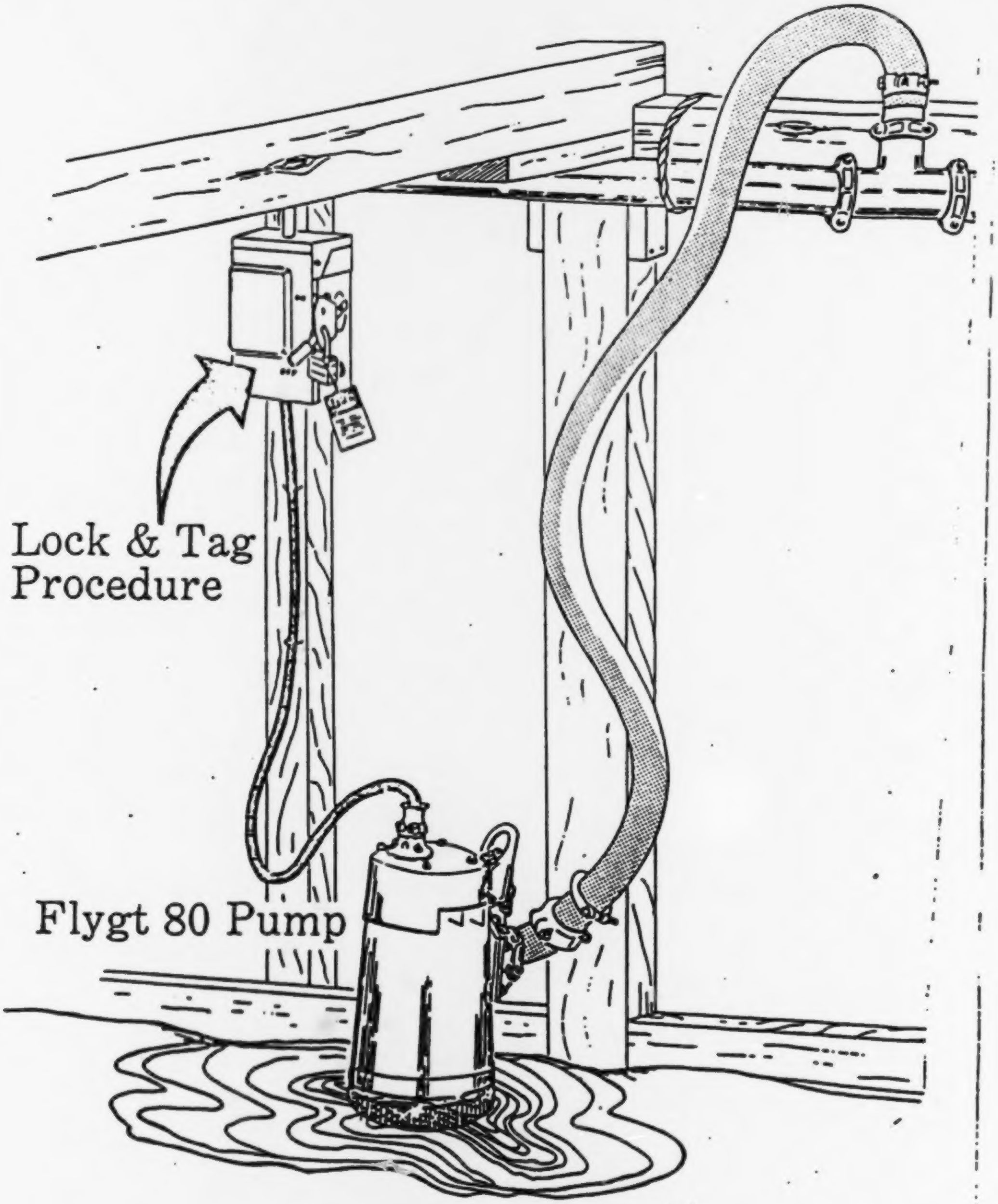

Rails
Slusher Motor
Side Boards
Slusher Bucket

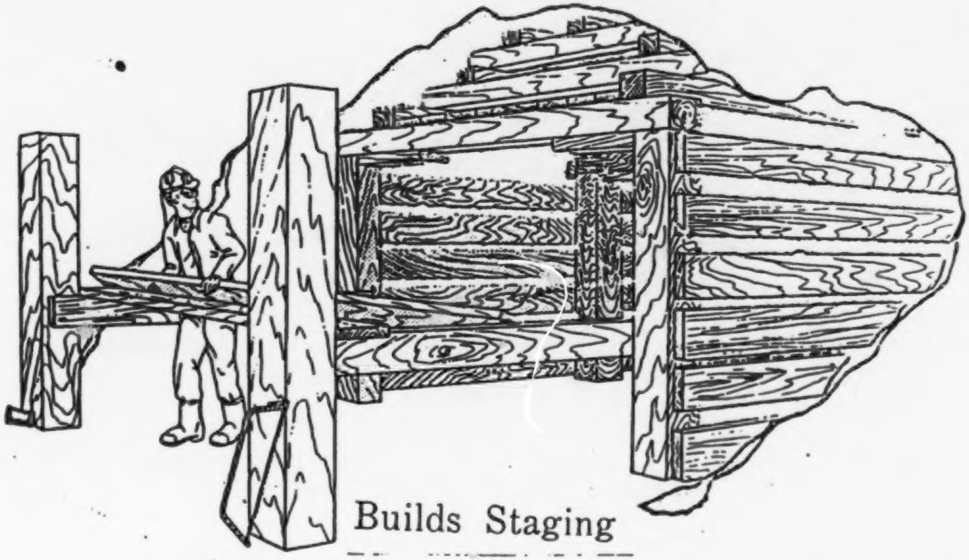
4.4

Water Pump Installation


Lock & Tag
Procedure
Gorman Pump

Water Pump Installation

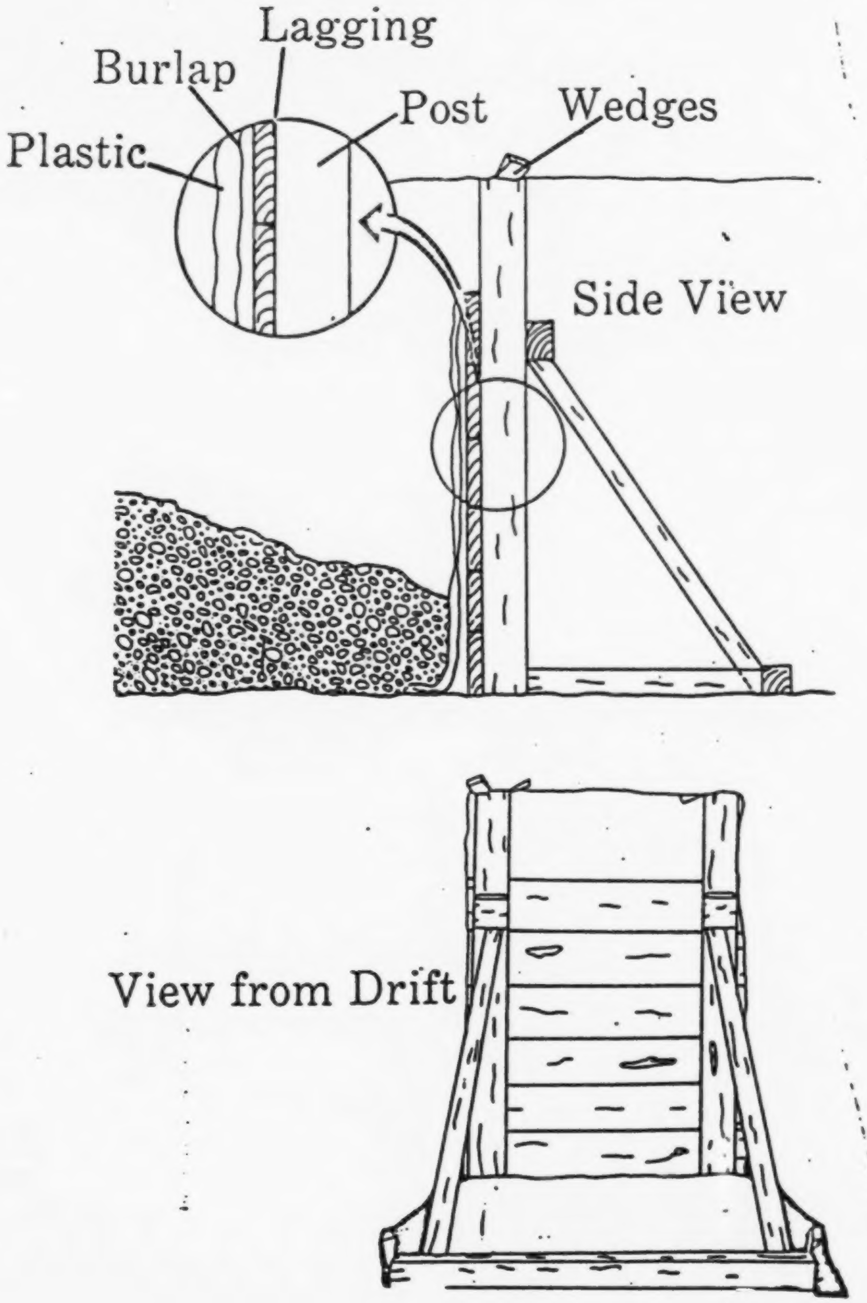

Lock & Tag Procedure
Flygt 80 Pump



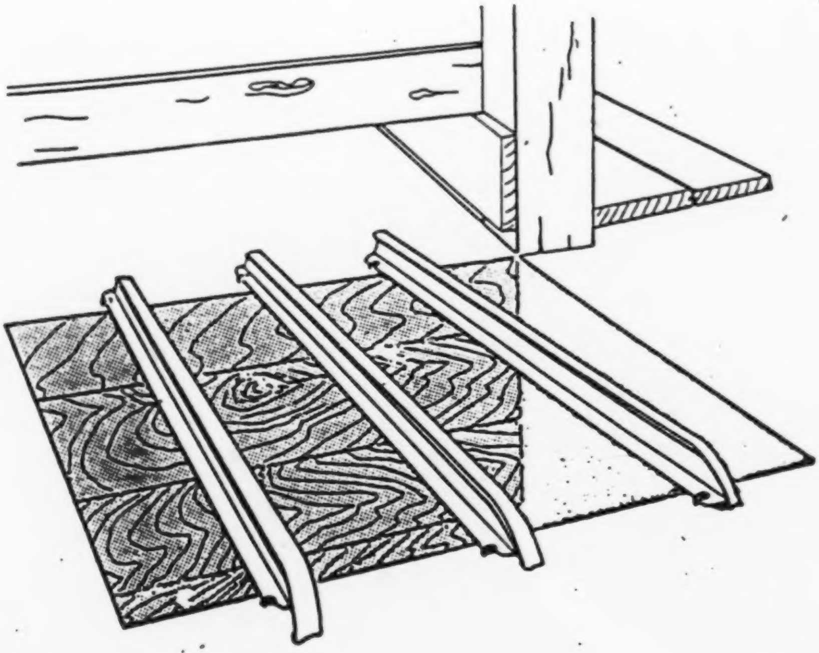
Builds Staging

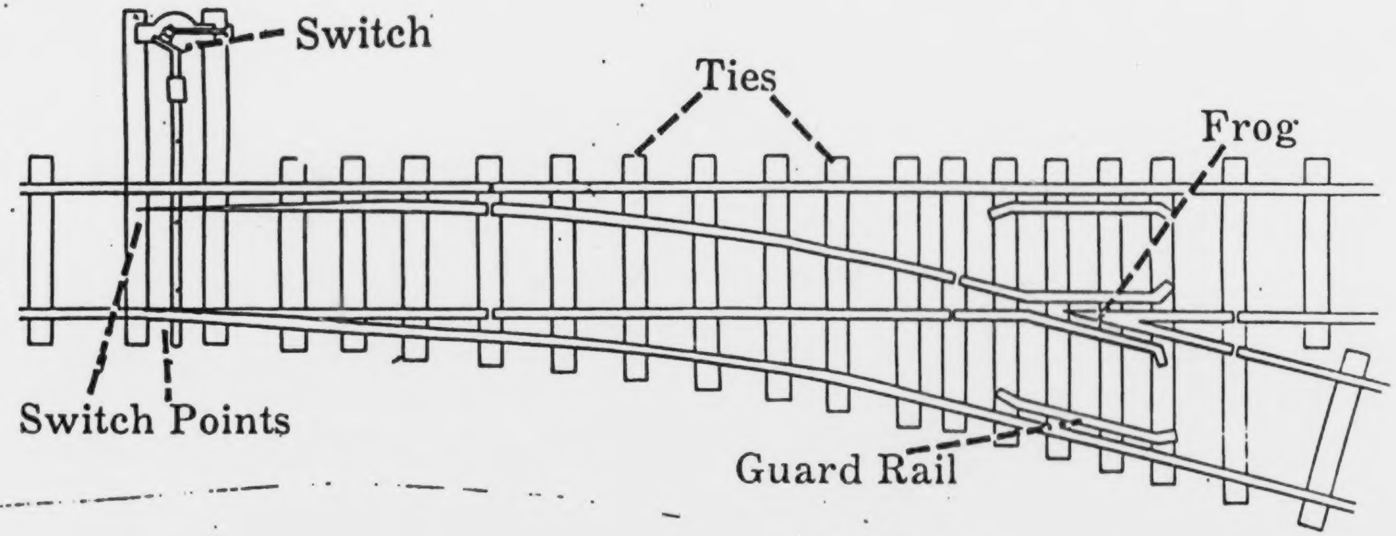
4.6

Bulkhead Installation

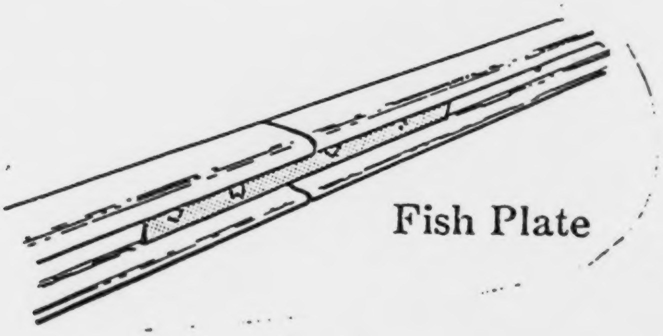

Lagging
Burlap
Post
Wedges
Plastic
Side View
View from Drift

Grizzly Installed In Raise

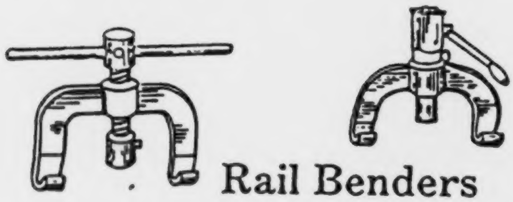



Switch
Ties
Frog
Switch Points
Guard Rail

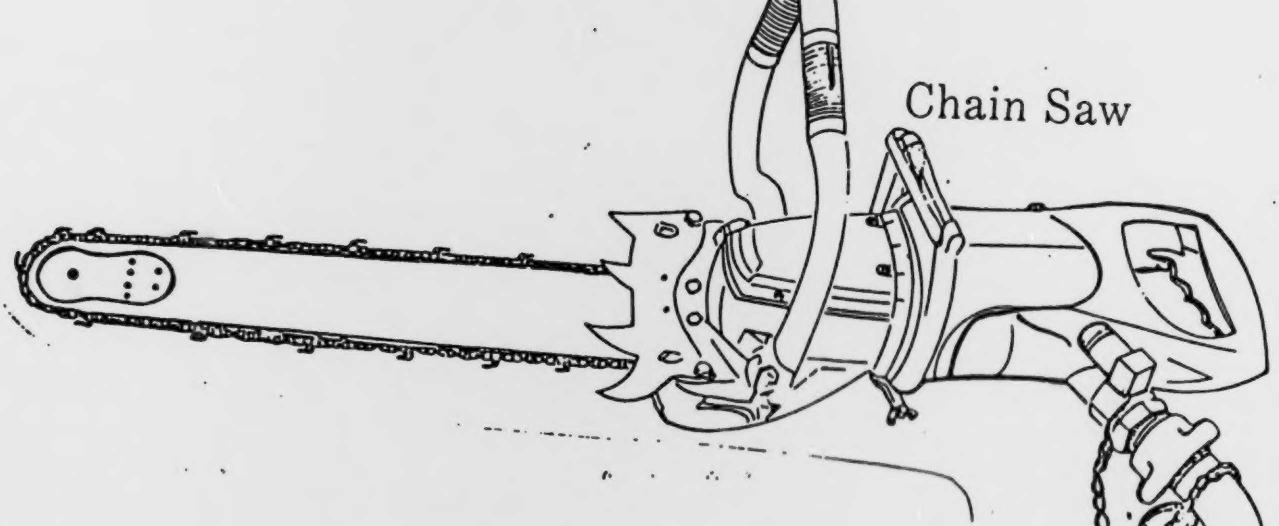
5.1

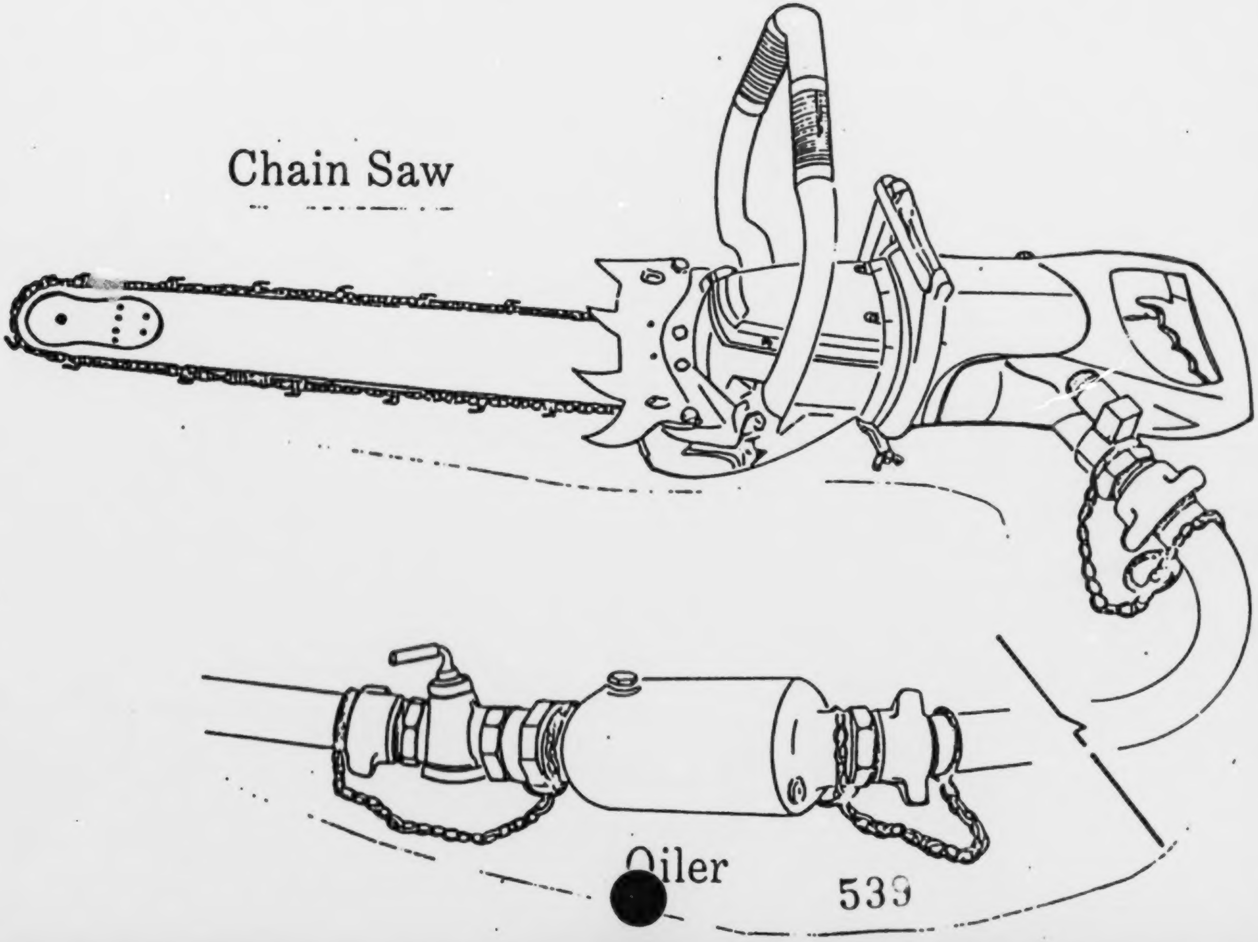


Fish Plate

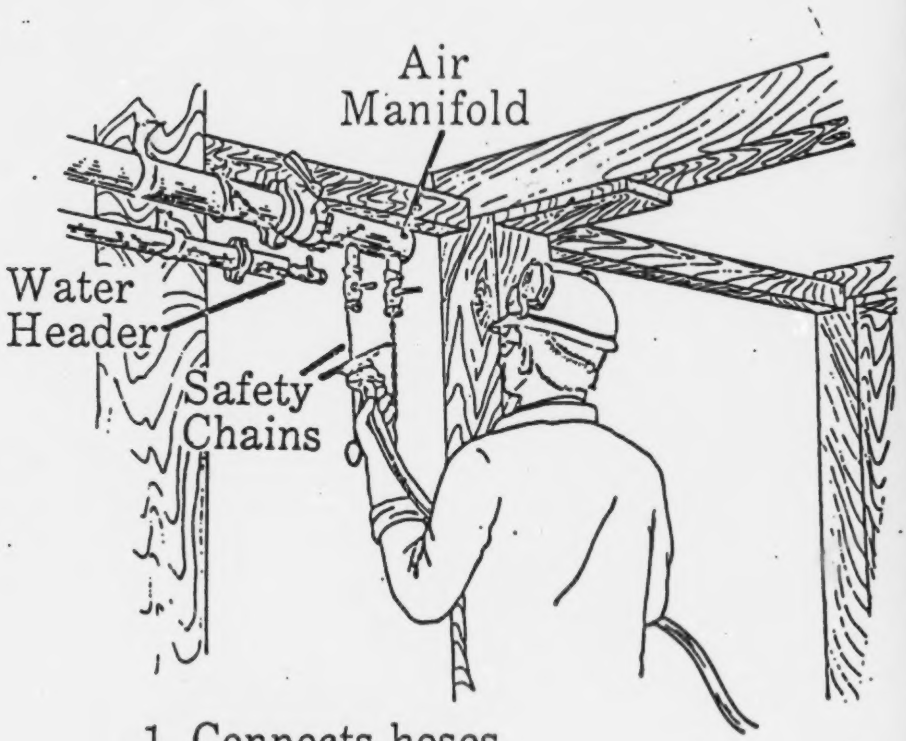


Rail Benders


Chain Saw
Oiler


Chain Saw
Oiler

-03) Connecting Hoses


Air Manifold
Water Header
Safety Chains

1. Connects hoses.
2. Secures hoses.
3. Cleans (blows) hoses.

PROCEDURE SHEET FOR SAFE DRILLING PRACTICE

Definition:

Logical Step ------ Any step that advances the operation forward.

Operational Hint -- This is any useful hint that may be used to make the logical step easier or to help break the operation.

Safety Hint ------- This is any safe operating practice that should be practiced at this particular step.

This procedure sheet assumes a continuing stope operation. The procedure begins as a miner comes into a stope area and starts the drilling operation.

SAFE DRILLING PROCEDURE

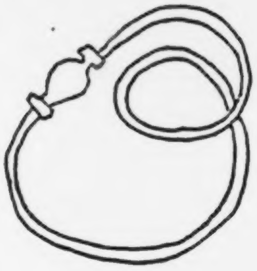
Logical Step	Operating Hints	Safety Hints
1. Carry scaling bar to work face.		Bar down work face prior setting up rock drill.
2. Carry rock drill from storage area to work face.	Stand the drill upright against the rib.	Wash down face. Check missed holes.
3. Lay out air and water hoses.	Return to raise and clear air hose of any foreign blast material by gradually turning on air for a short burst.	Be sure end of air hose i secure to prevent whippin
4. Carry oiler hose and oiler to work face.	It is good operating practice to remove oiler and oiler hose after drilling (see illustration 1). This practice prevents foreign material and blast debris from getting in rock drill.	
5. Attach oiler to air hose.		Secure wingnut by strikin with a wrench. (Note: A connections that are subjected to vibration must securely fastened -- Saf chains are fastened to a hose.)

Logical Step	Operating Hints	Safety Hints
6. Attach water hose to rock drill.	Wash down rock drill to remove dust and foreign matter.	
7. Attach oiler hose.	Pour approx. 1/2 cup oil in air hose to insure proper lubrication of rock drill until oiler takes over.	Secure oiler hose to rock drill with safety chain.
8. Check oiler.	Oiler must be filled at beginning of drilling shift. One oiler full lasts approx. 3 hrs. Oiler must be cleaned around filler plug before opening for refilling. Blast debris will plug the oiler and render it ineffective.	(1) Oiler plug must be secured by striking with a wrench. (2) Be sure air is off at oiler before filling. Check Point: Check rock drill to make sure air leg control is in an "off" position. Check throttle and water valve to see that they are off. Be sure to predetermine "off" position.
9. Return to raise and turn on air and water.	Turn on air and water slowly to check for broken hoses. (Note: Repair all broken or leaking hoses immediately.)	Be sure to use proper tools and correct method and materials for repair.
10. Check drill steel.	(1) Each steel must have a square striking face. (2) Each steel must be straight. (3) Check tapered end to see that entire taper is intact -- and not plugged.	Bent steel cause extreme vibration and whipping, causing undue wear on rock drill.
11. Take steel to drill face.	(1) Put bits on steel and rap sharply against face. (2) Stand steel with bit down to prevent plugging steel.	
12. Turn on air at the oiler.		
13. Turn on water at machine.		

Logical Step	Operating Hints	Safety Hints
14. Set machine up against the work face.	Set leg at an angle of approx. 60° from flat behind you.	Make sure spade is pointed downward into muck. (See illus. 2)
15. Set steel against face and insert steel into rock drill chuck.	Oil shank of steel to prevent excessive wear on chuck.	
16. Lean rock drill over against wall.	This prevents chuck from getting rocks and debris in it.	
17. Inspect drill face for loose rock prior to drilling.		Use proper tools to scale down face.
18. Select proper position of drill hole.		
19. Turn throttle on half-throttle and guide steel until hole is collared.	Try to have steel aligned perpendicular to plane of face where collaring hole. Realign machine for correct hole alignment after hole is penetrated to approx. 1" of depth.	(1) Watch for loose rock falling from face. (2) Wear safety glasses prevent eye injury.
20. Turn on full throttle.		
21. Complete the hole.	This is a repetitive maneuver that is repeated until the round is drilled out. See blasting procedure for alignment of holes in the round.	
22. Remove steel from machine.	Stand up against rib with bit end down.	
23. Shut off air and water at raise. Stand machine against rib.		
24. Take air and water hoses off from machine.		
25. Coil oil hose and oiler.	Secure oiler hose to oiler.	

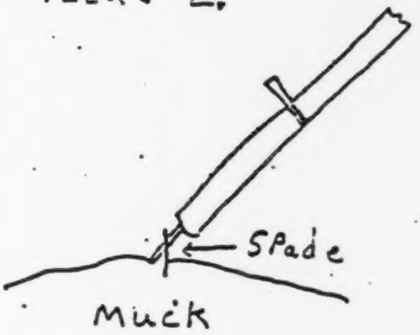
Logical Step	Operating Hints	Safety Hints
26. Roll up air hose. Roll up water hose.	(See Illustration 3.)	Be sure walkway is free from tripping hazards.
27. Take rock drill to raise.		
28. Take steel to raise.	(1) Store steel with the bit end down. (2) The water hole in the steel is slightly larger at the shank end of the steel and will plug easier.	Store steel in a rack vertically or horizontally. Treat steel as the machin that it is. (See Illus. 4)
29. Check drill holes to see that they are free of drill cuttings.		
30. Use 1/2" blow pipe to clean holes.		Wear safety glasses whil blowing holes.

ILLUS 1.



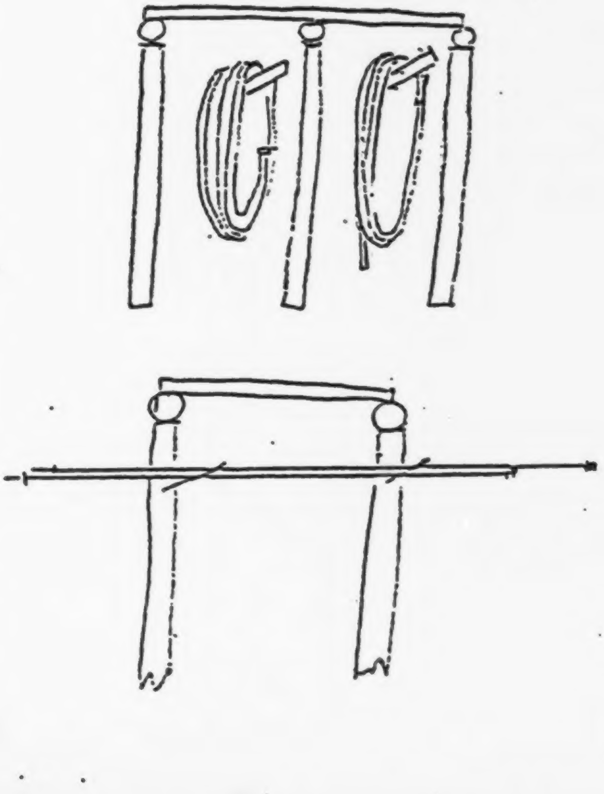
oiler hose and Oiler in STored Position

ILLus 2.



Jackleg STinger with Spade down in proper Position.

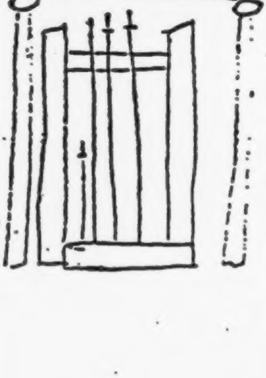
ILLus 3.



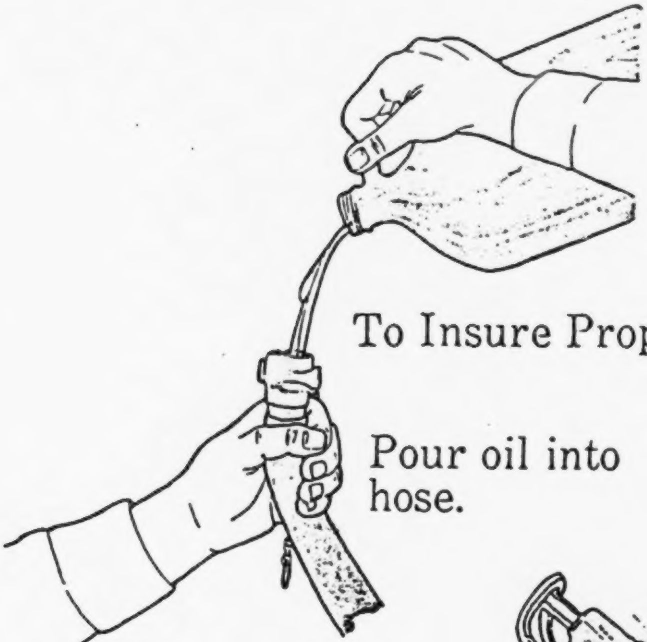
A Clean Workplace is A safe Workplace

Hang it up!

ILLus 4.

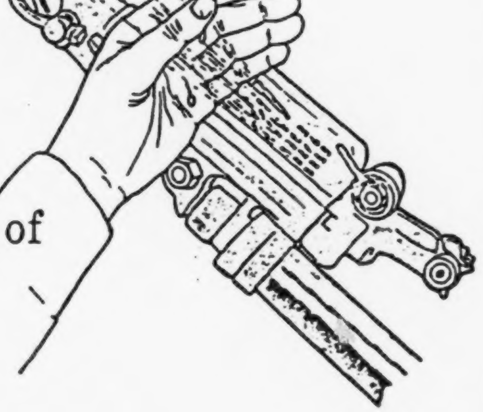


Always St
Drill STee
Bit Dow

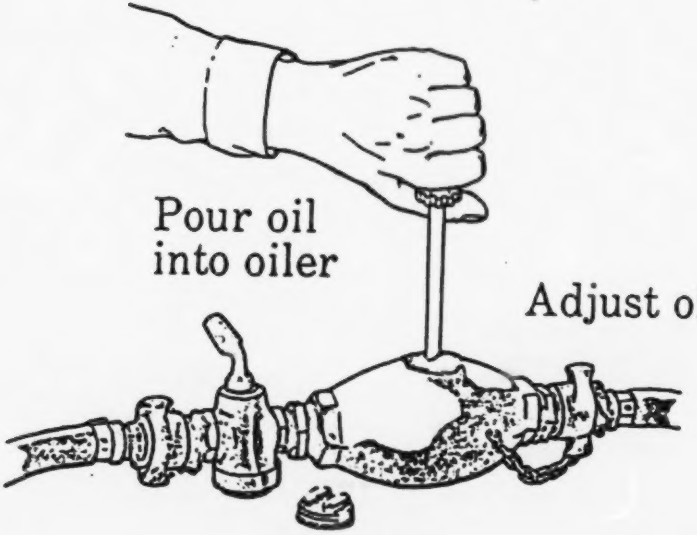


To Insure Proper Lubrication

Pour oil into hose.



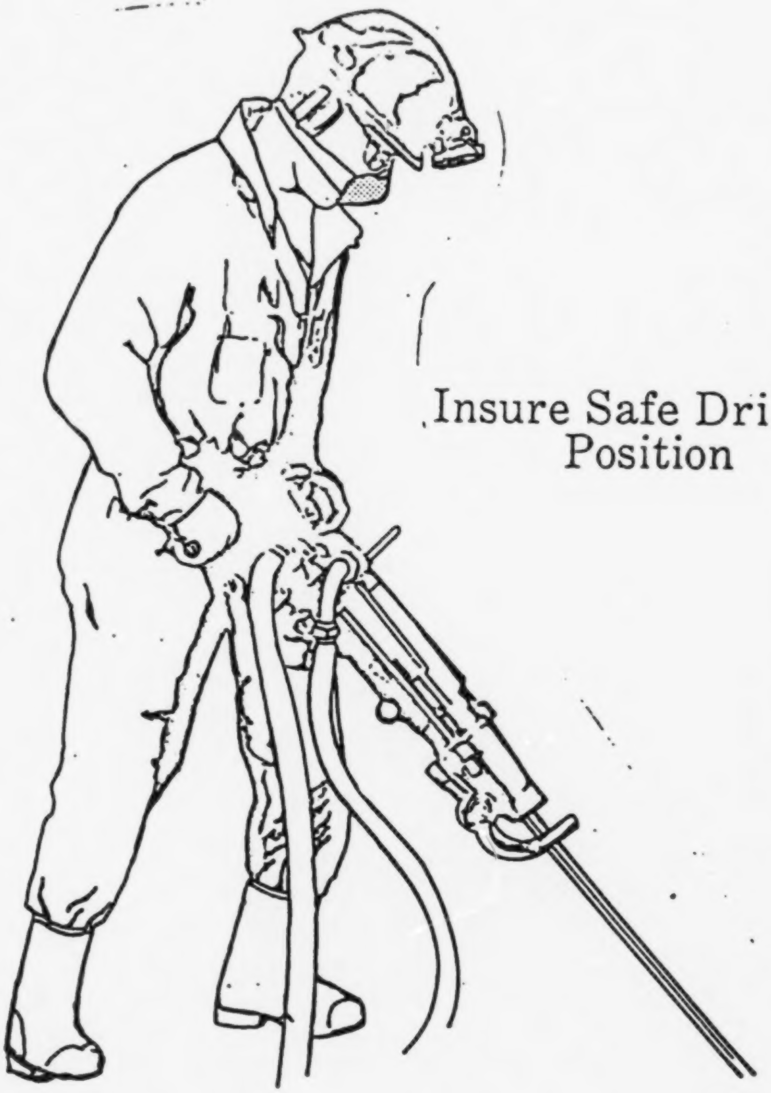
Hold hand in front of rock drill exhaust.



Pour oil into oiler

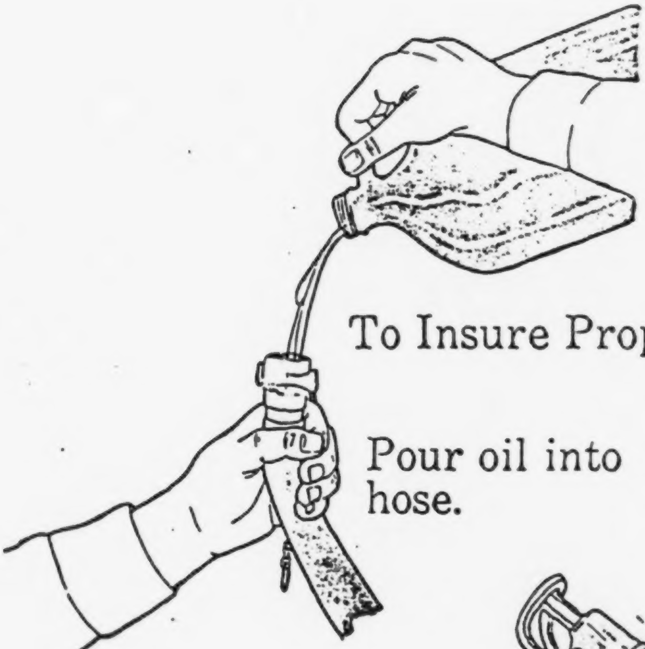
Adjust oiler.

-05



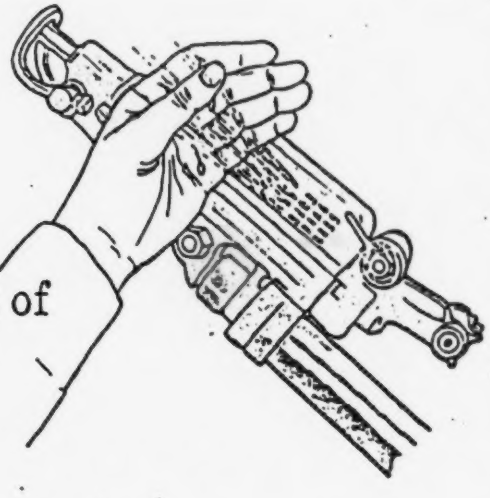
Insure Safe Drilling Position

Operating Air Jackhammer

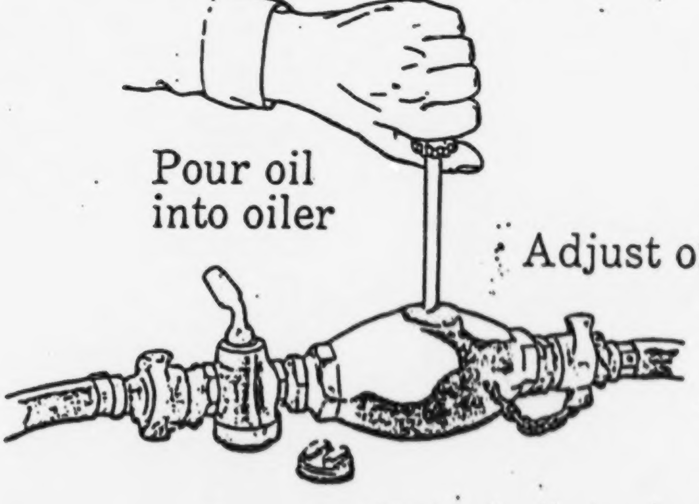


To Insure Proper Lubrication

Pour oil into hose.

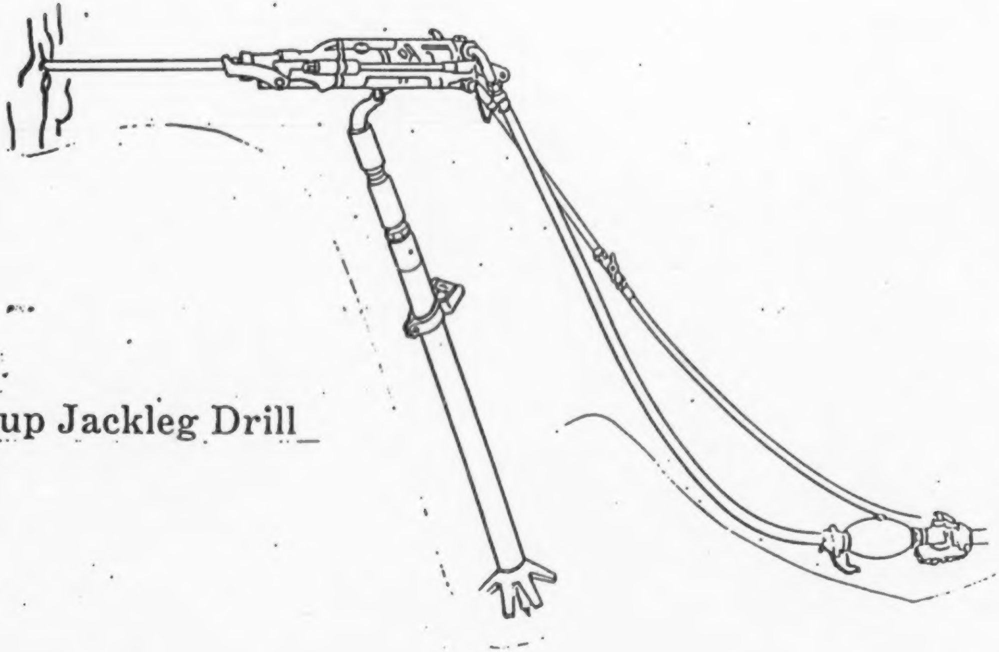


Hold hand in front of rock drill exhaust.



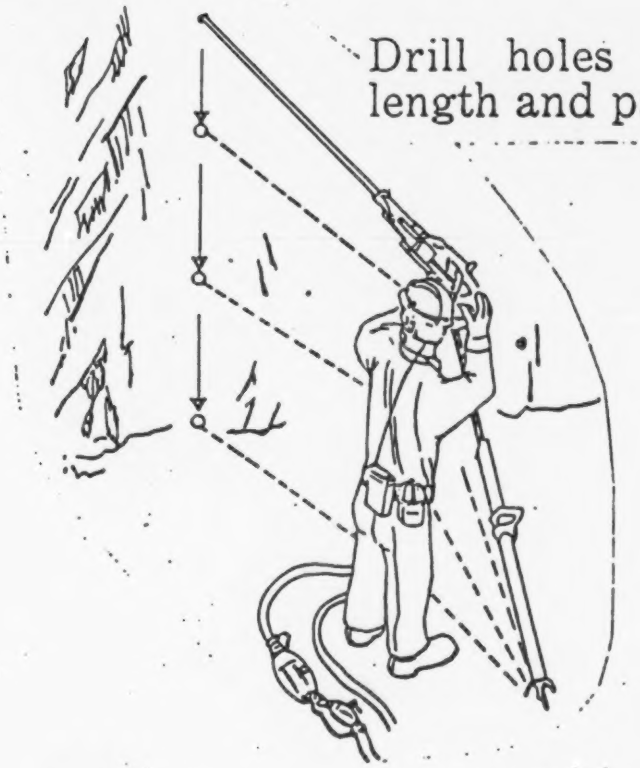
Pour oil into oiler

Adjust oiler.



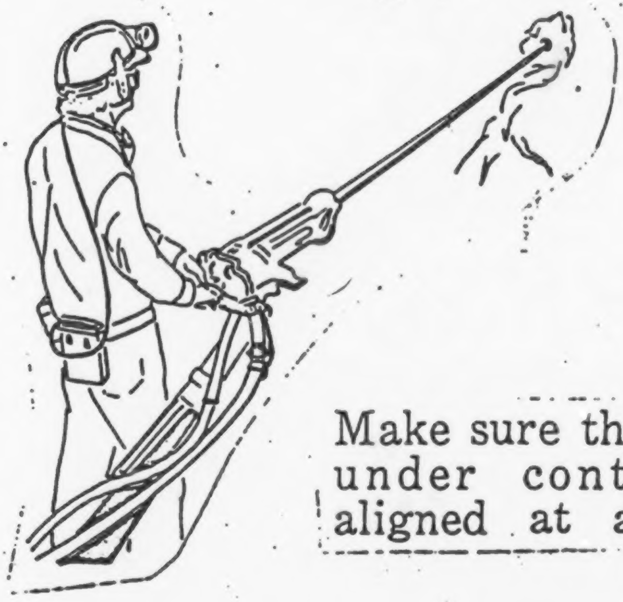
Set-up Jackleg Drill

-05#1



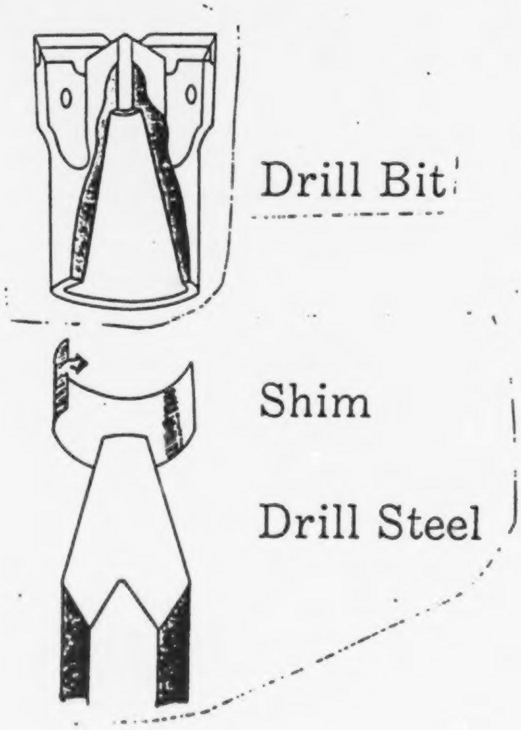
Drill holes to prope
length and pattern.

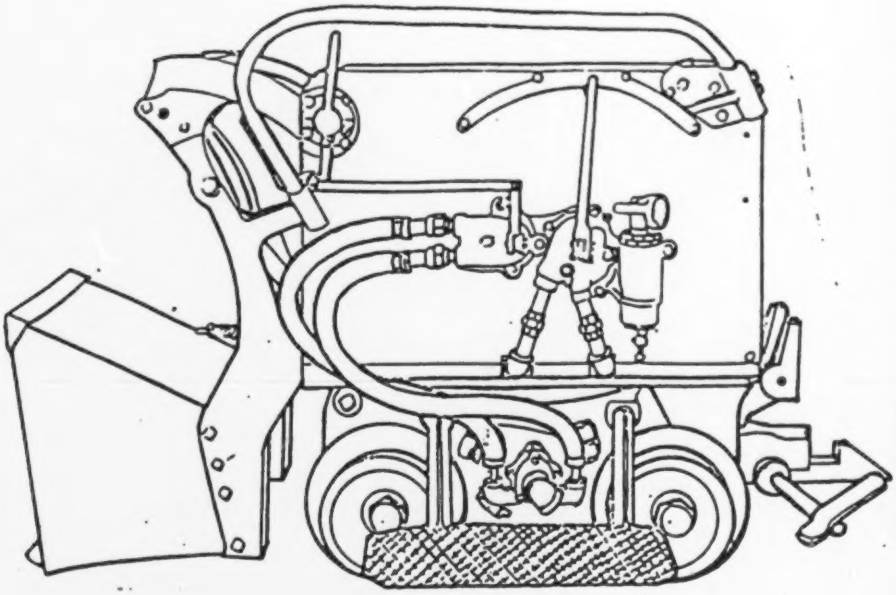
-05#2



Make sure that drill is under control and aligned at all times.

-07

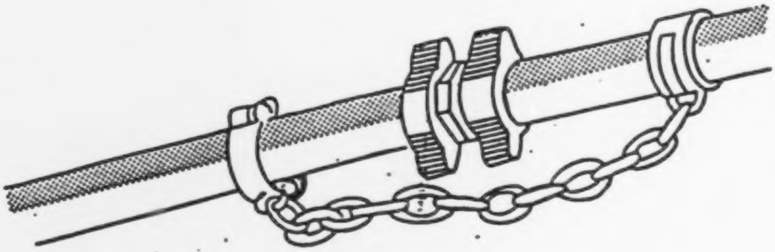

Drill Bit
Shim
Drill Steel

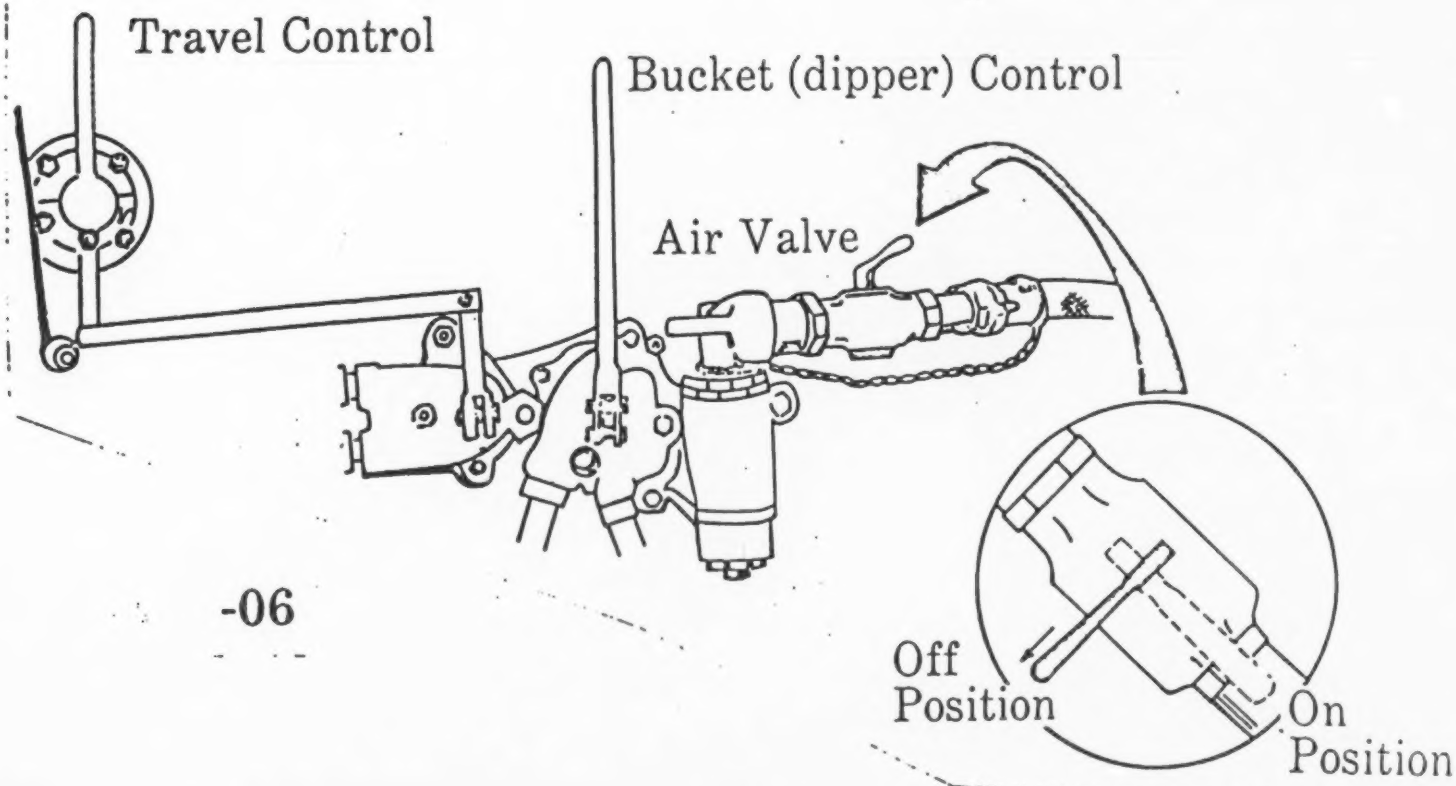


Mucking Machine

-03

Connect, blow clean and secure bullhose.



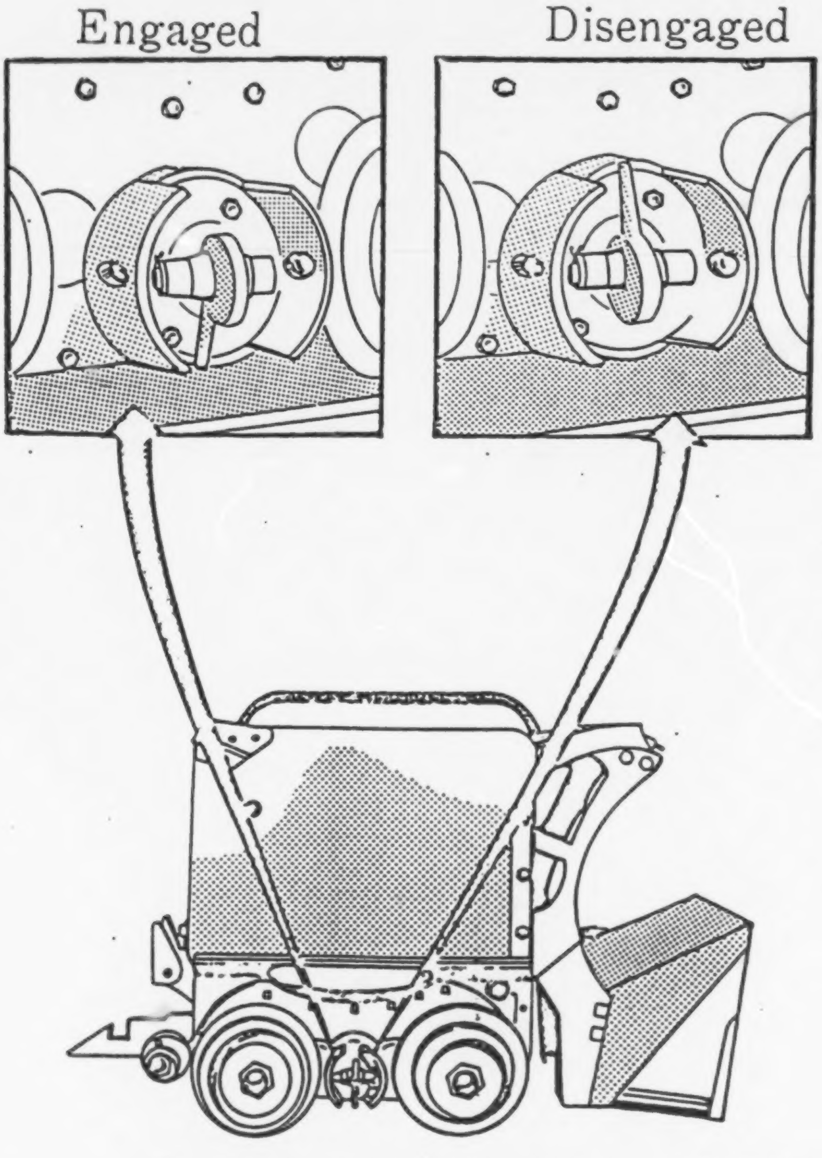

Travel Control
Bucket (dipper) Control
Air Valve
Off Position
On Position

-06

6.7

-08

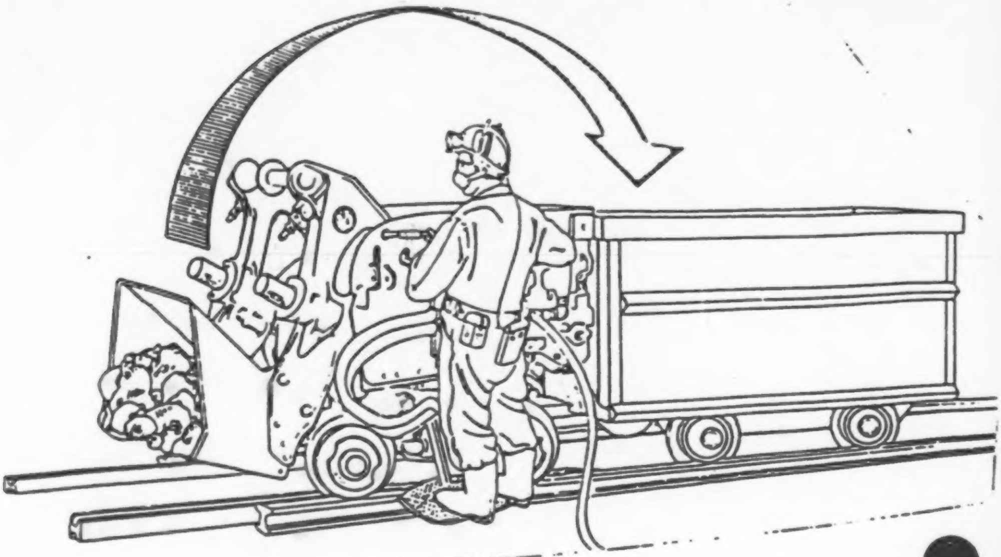
Travel Gear Procedure


Engaged
Disengaged

Gear engaged serves as a brake.

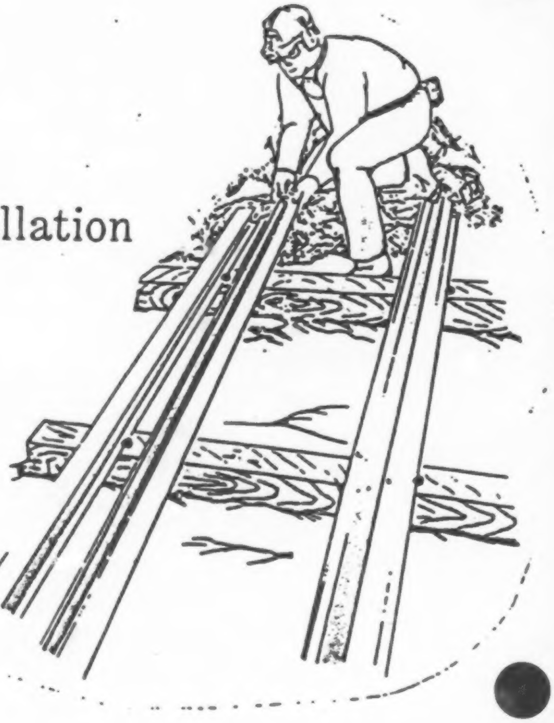
-06

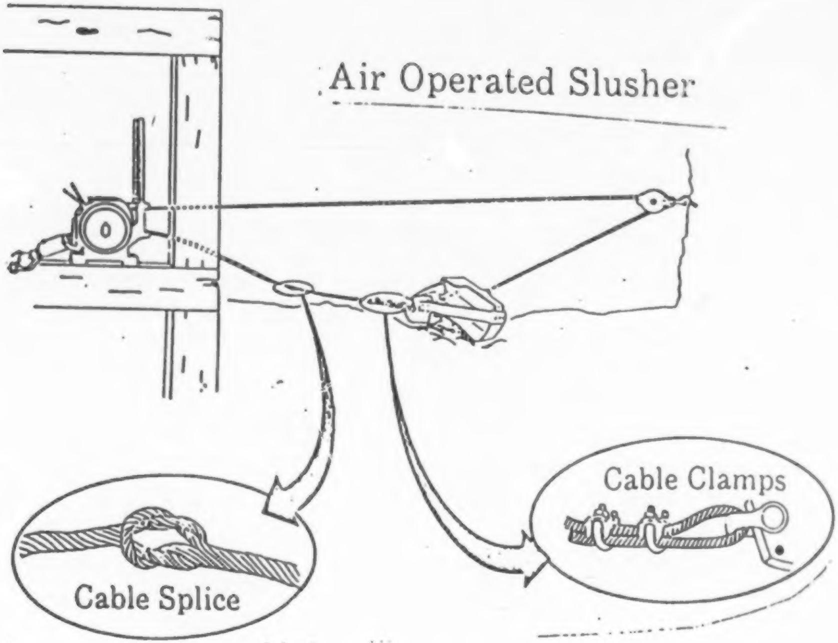
Mucking Operation



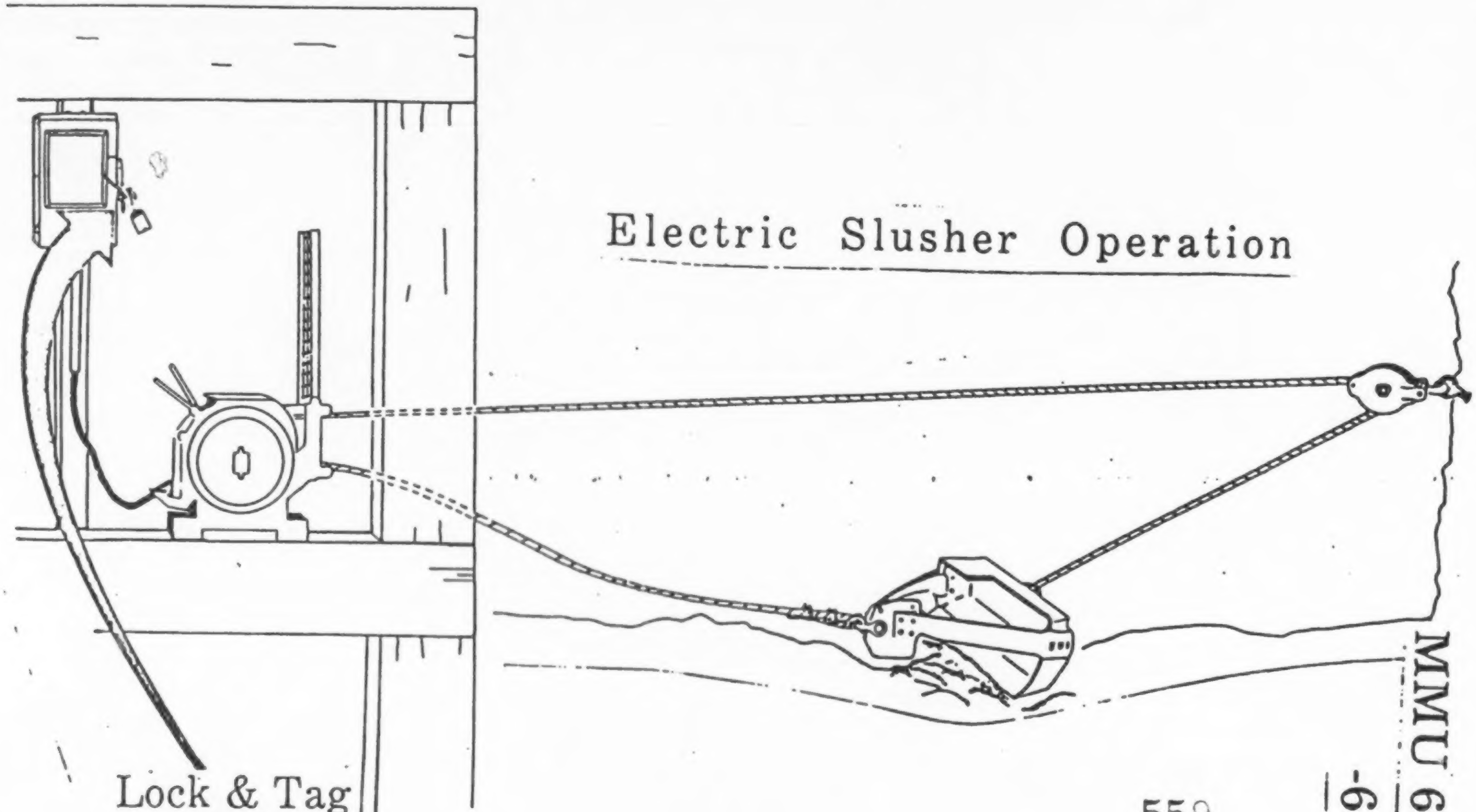
-07

Slide Rail Installation




Air Operated Slusher
Cable Clamps
Cable Splice

6.9
-6.10



Electric Slusher Operation

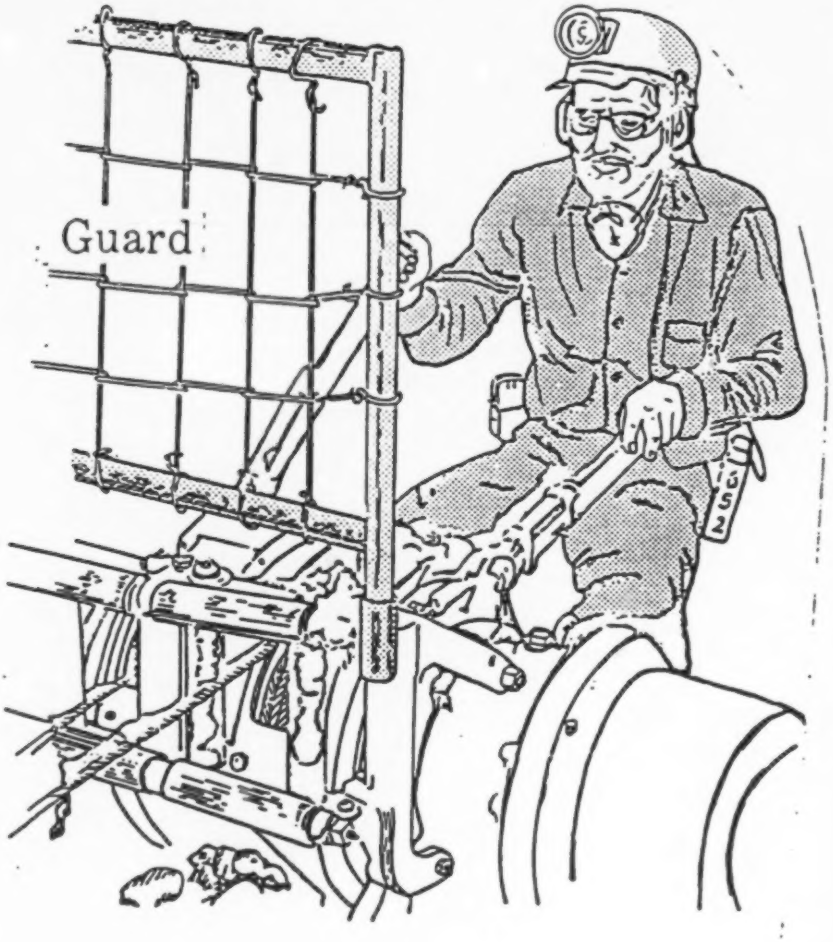
558

Lock & Tag
Procedure

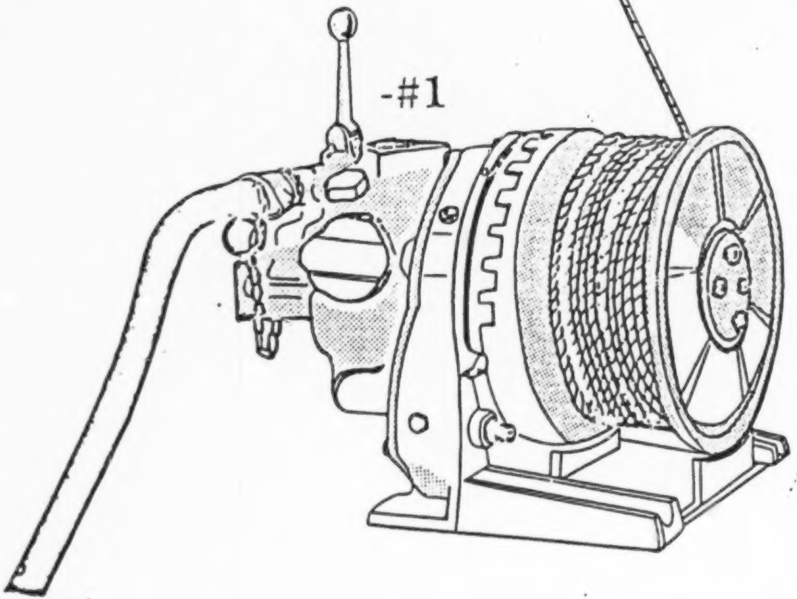
559

MMU 6.11
-6.-2

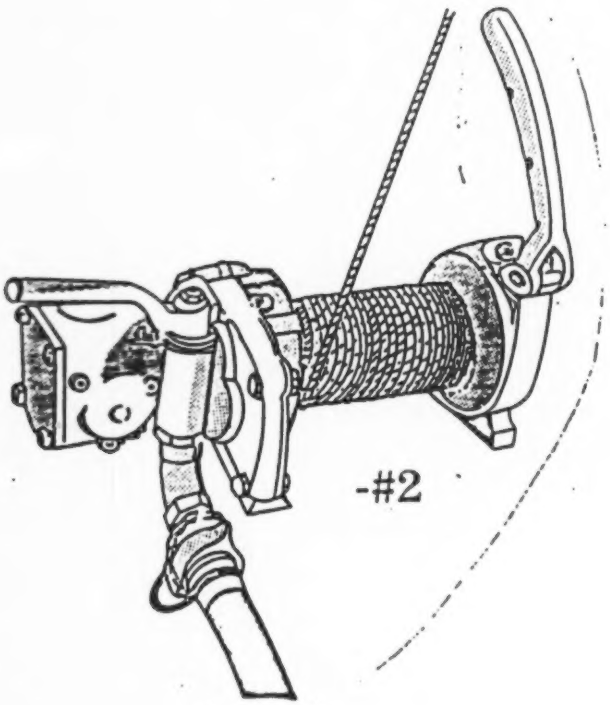
Operating Electric Slusher



Tugger Hoists



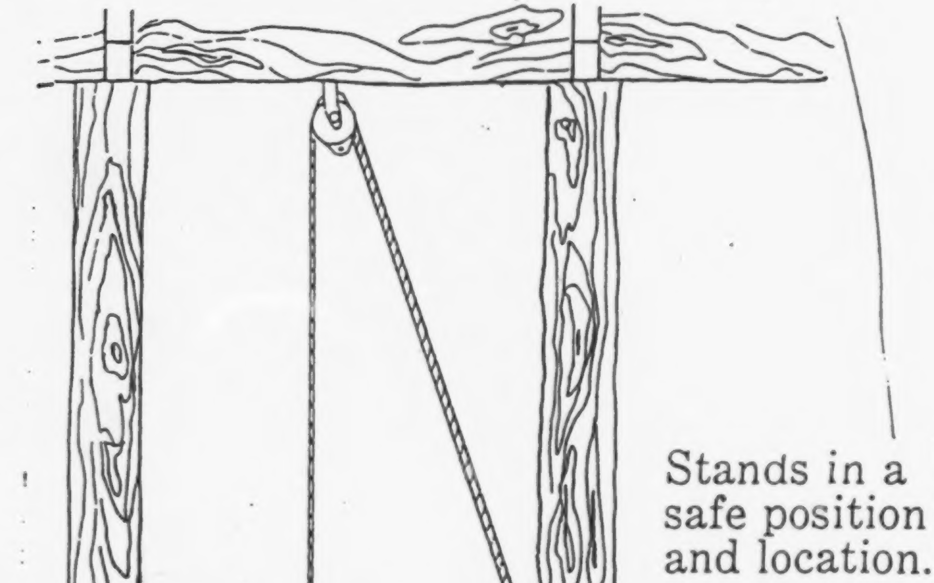
-#1



-#2

6.14

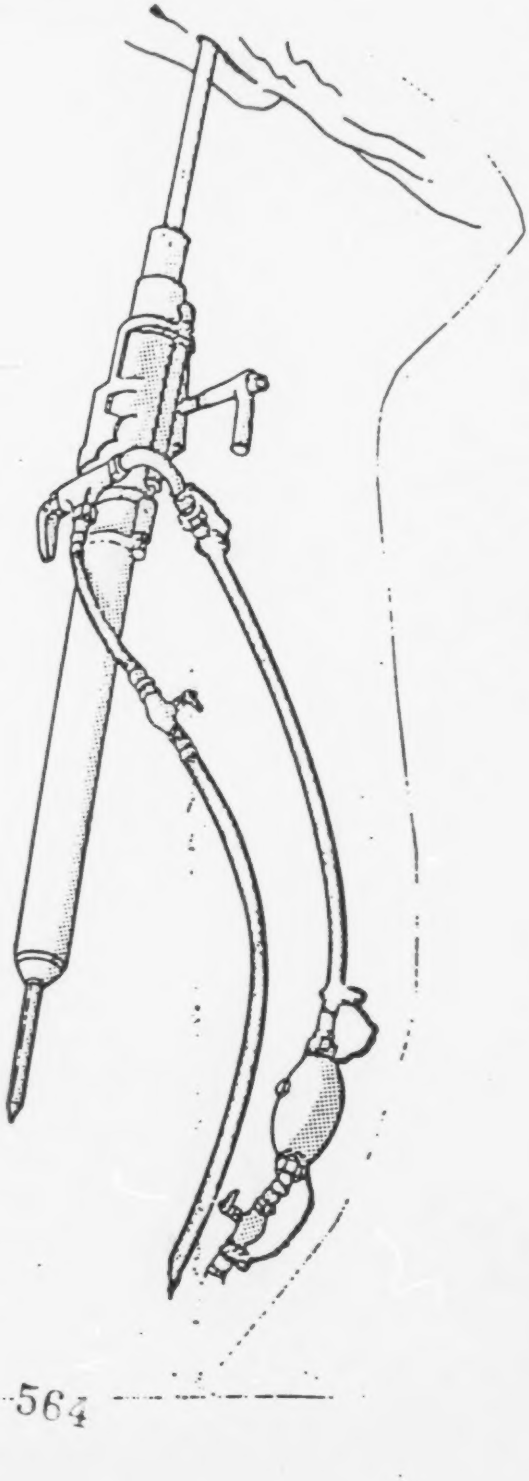
Air Tugger Operation



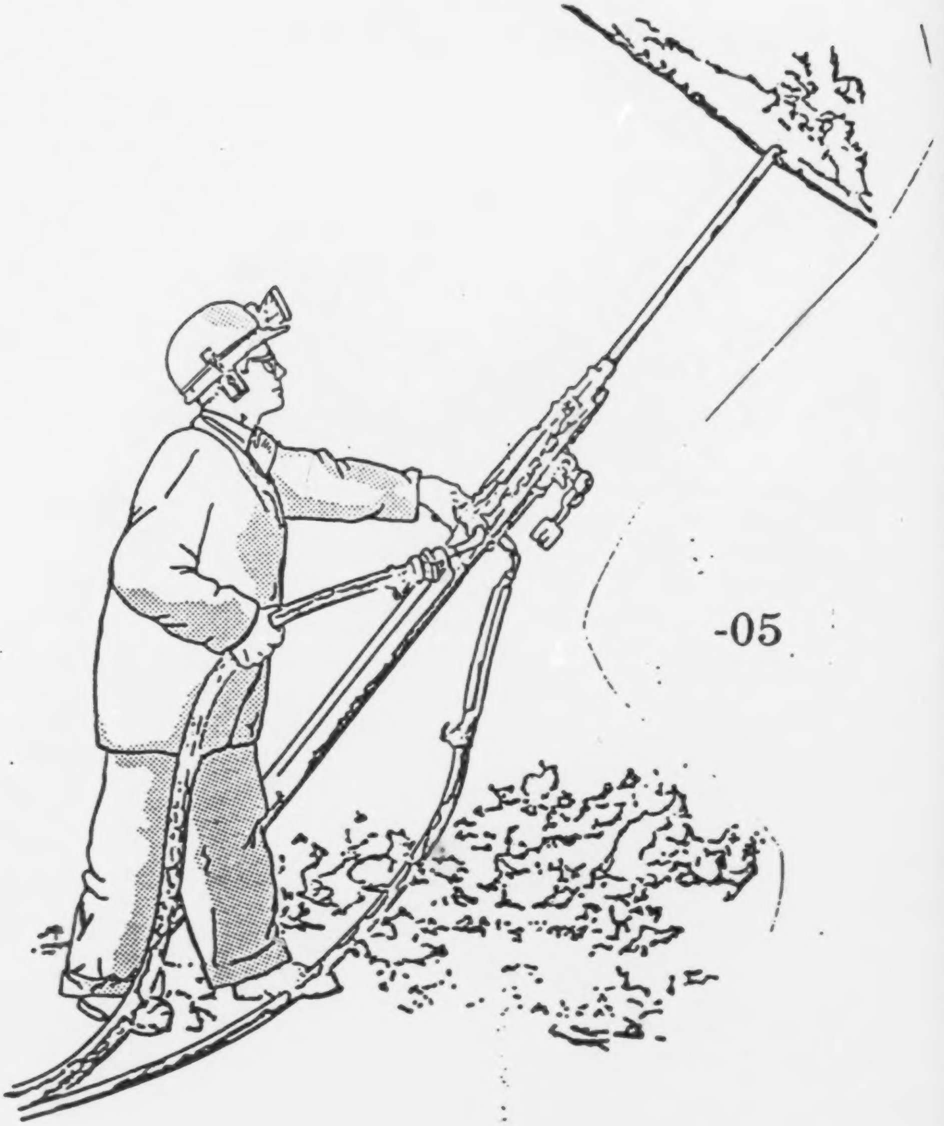
Stands in a safe position and location.

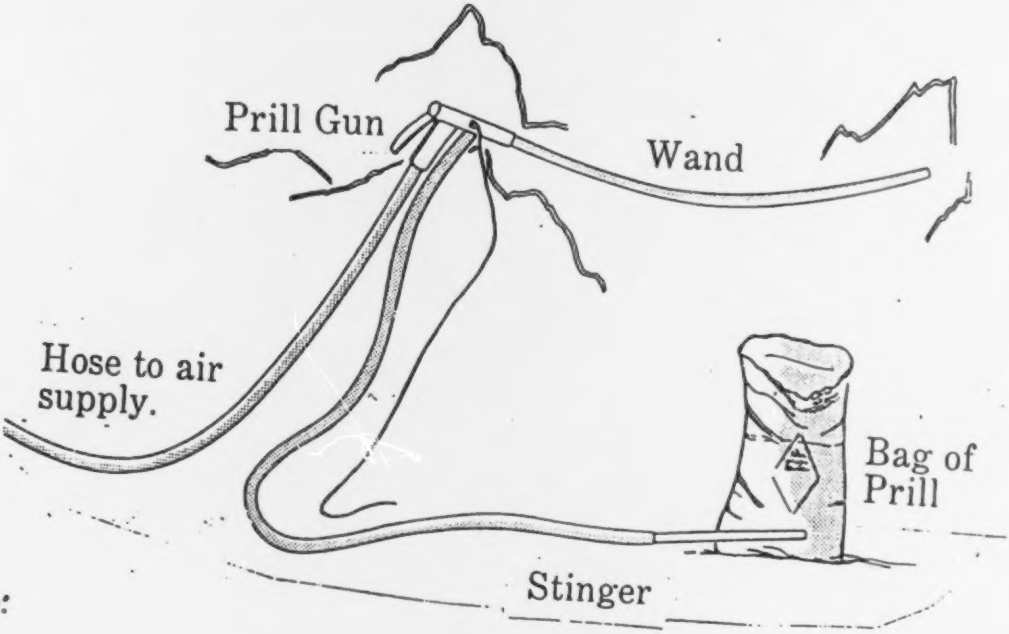
Safely secures load to cable.

Sets Up Stoper Drill



Operates Stoper Drill

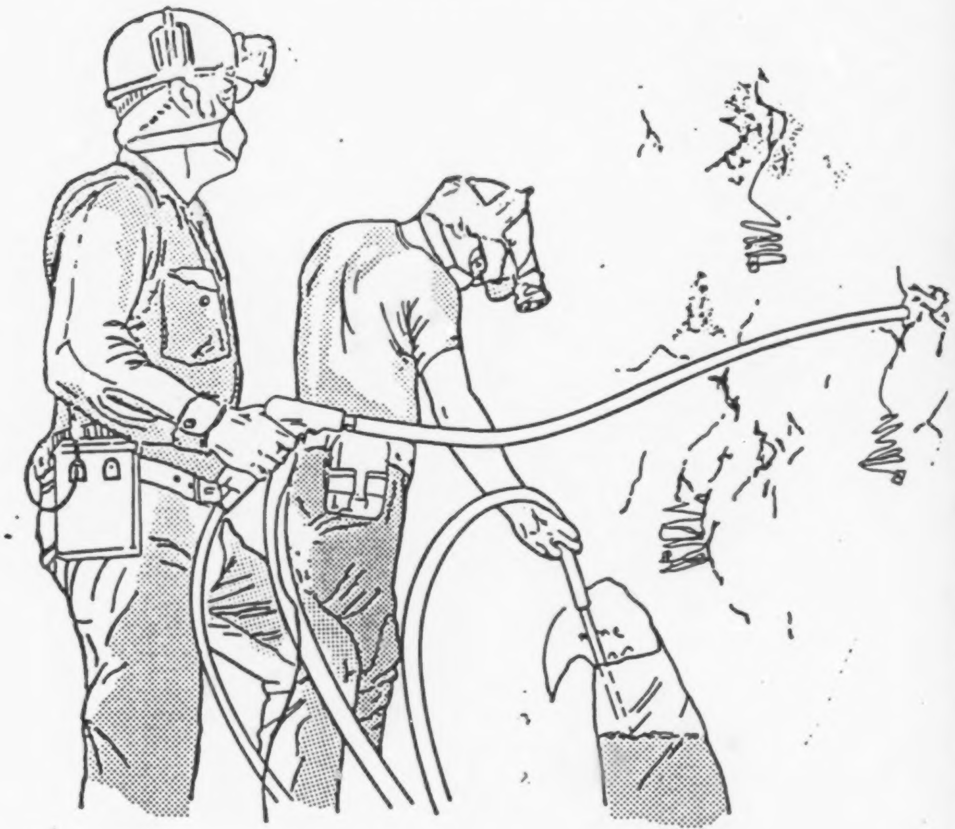



Prill Gun
Wand
Hose to air supply.
Bag of Prill
Stinger

Set-Up Prill Gun

6.1

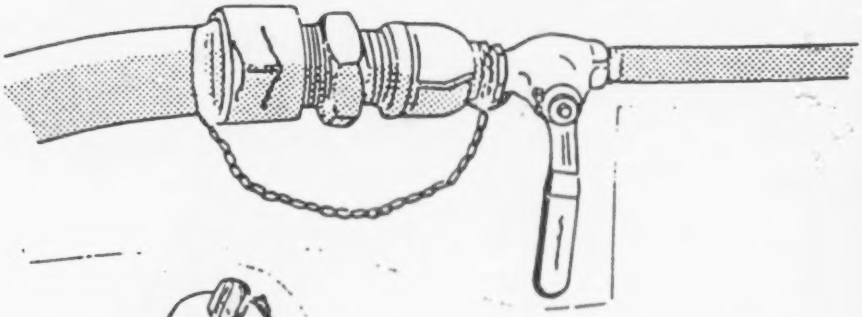
-09 Operation of Prill Gun

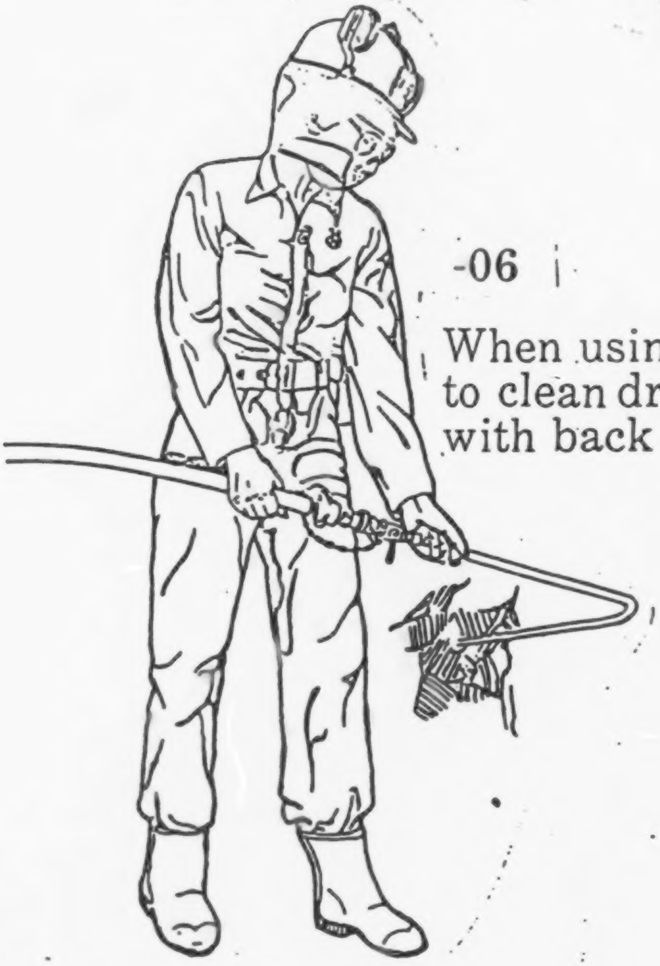


Ground by using wire or wetting muck in immediate area.

Attaching blow pipe

-03



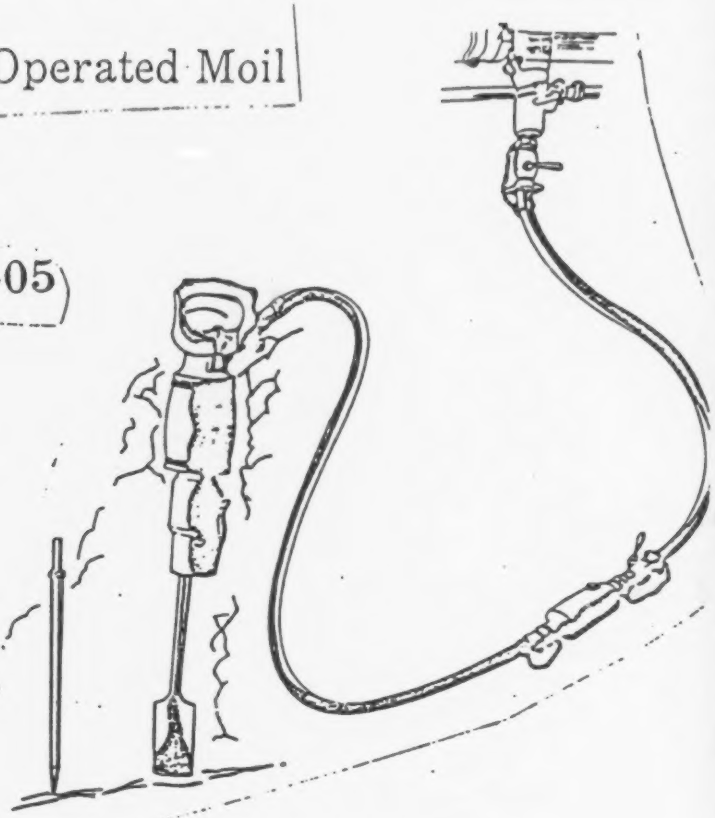


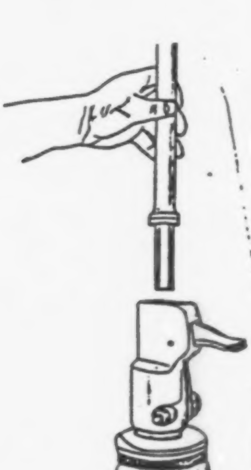
-06

When using the blow pipe to clean drill holes, stand with back to hole.

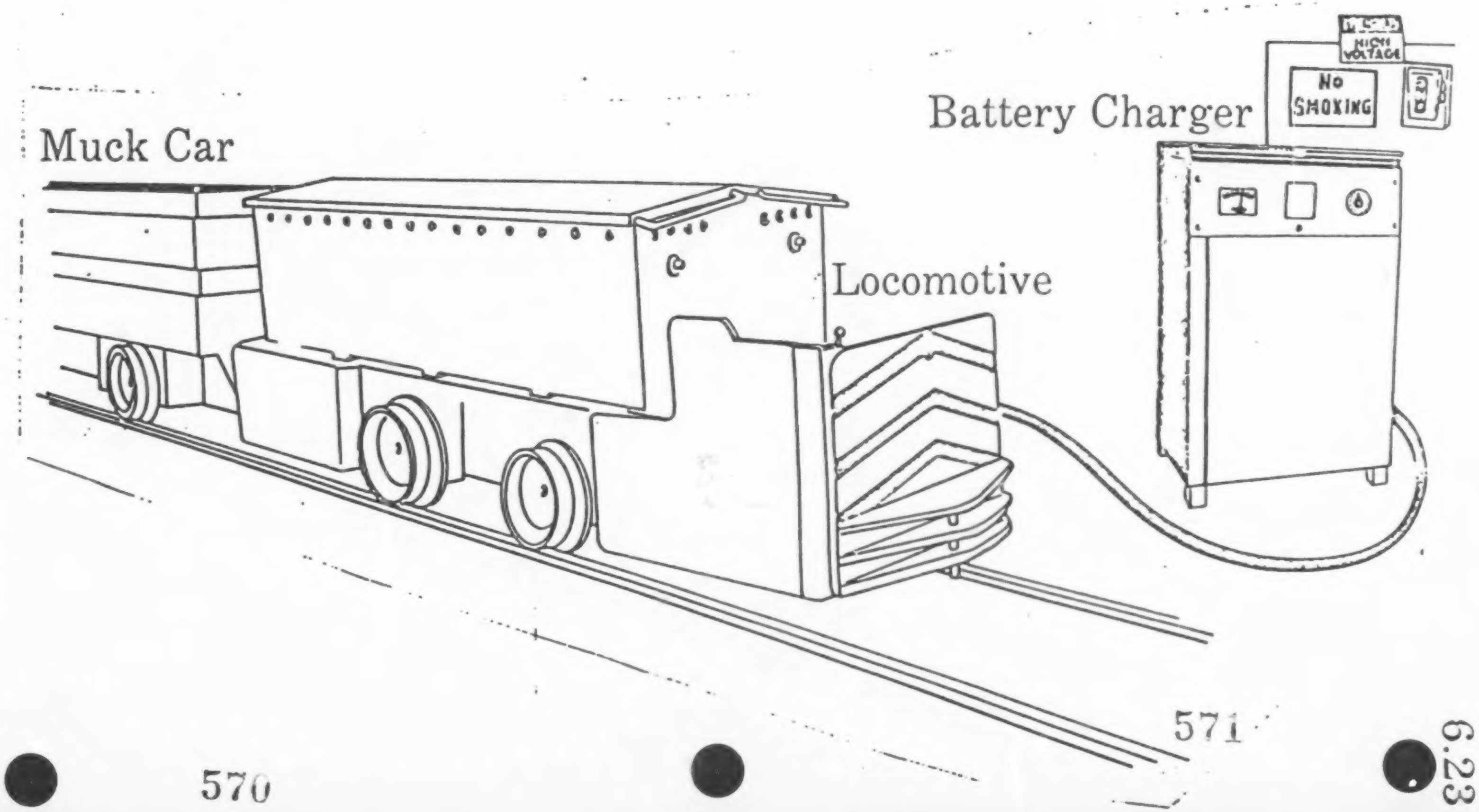
Air Operated Moil

-05


Moiler Steel

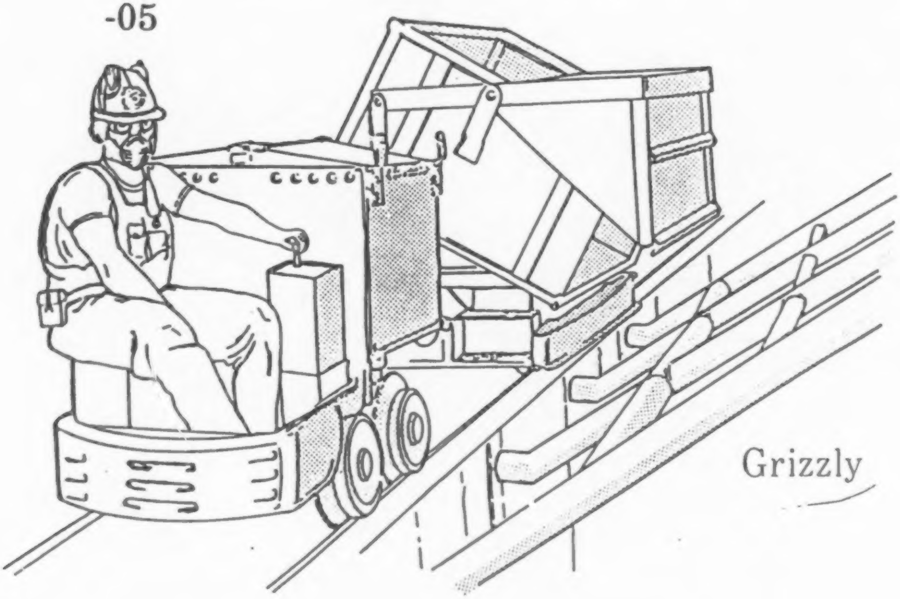


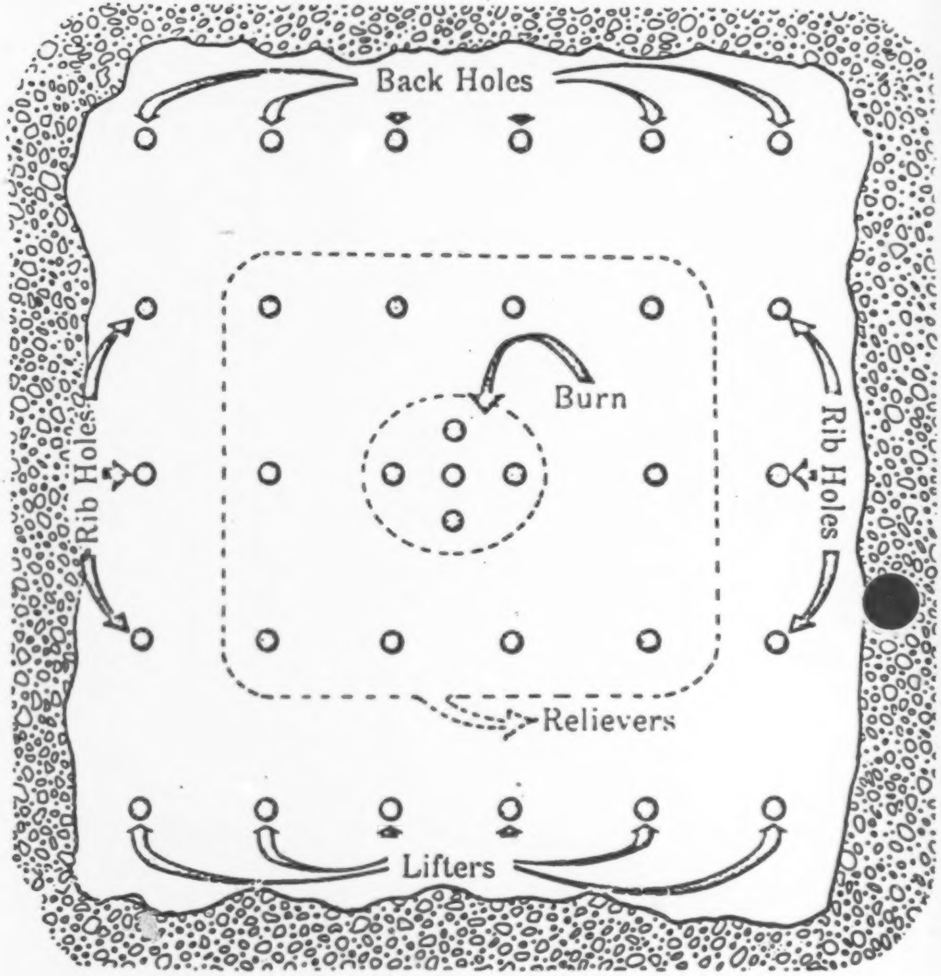
Inserting steel into moil.


Muck Car
Battery Charger
HIGH VOLTAGE
NO SMOKING
Locomotive

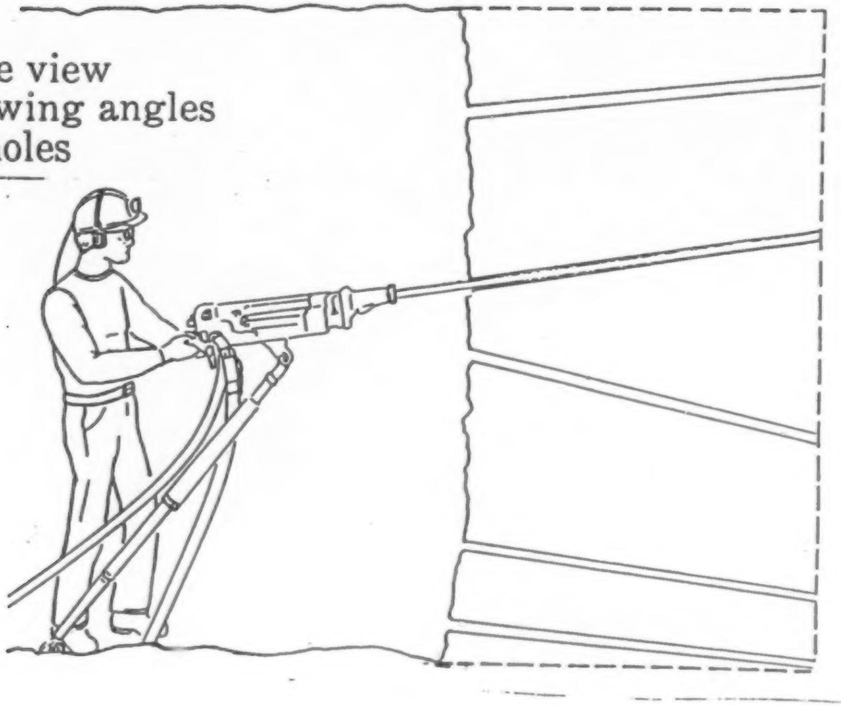
Train Operation

-05

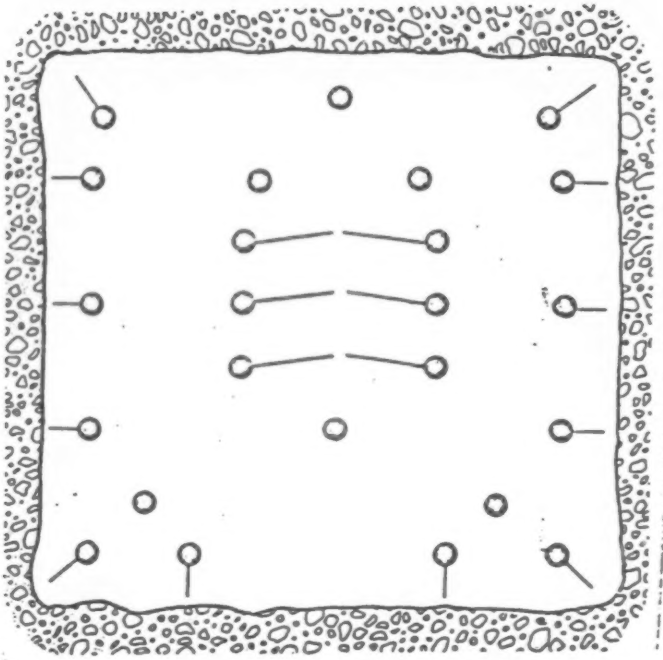



Back Holes
Rib Holes
Burn
Rib Holes
Relievers
Lifters

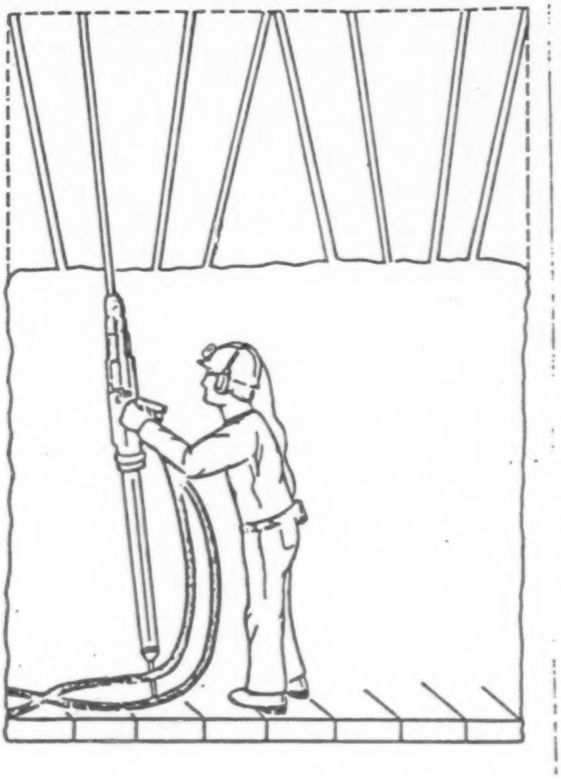
Front view
of round


Side view showing angles of holes

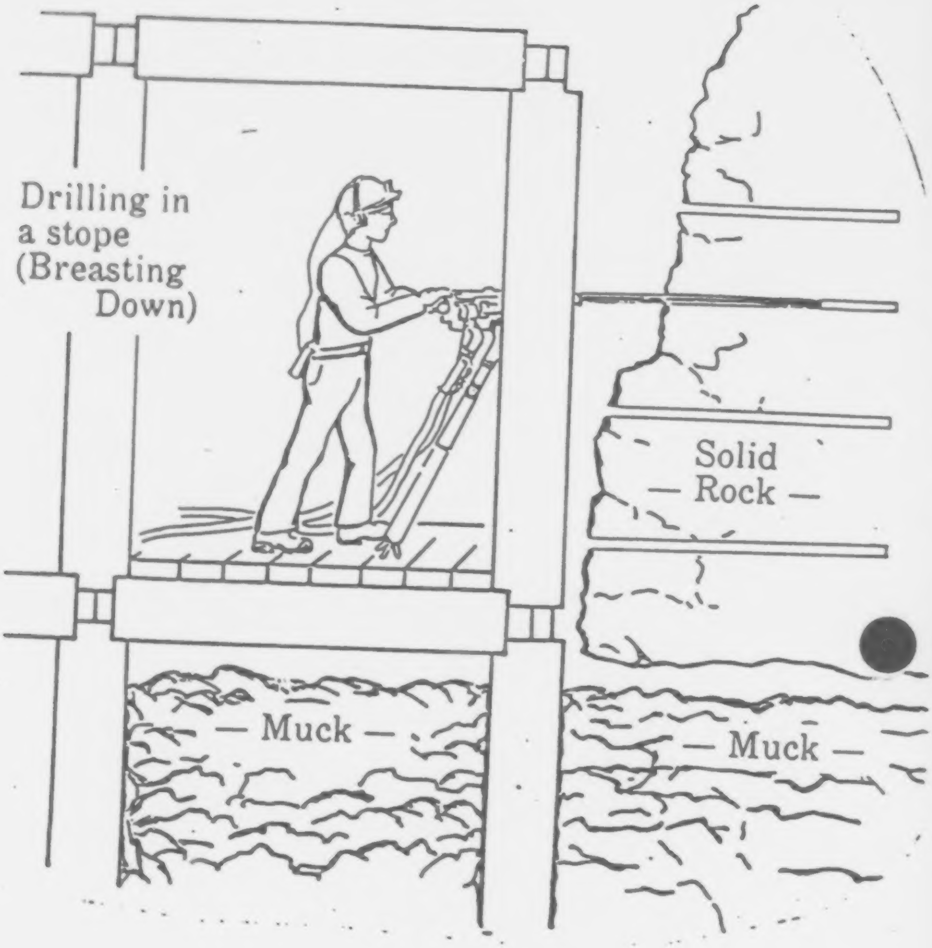
7.1



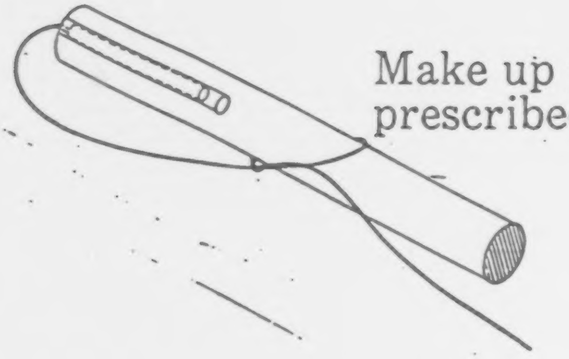
View looking up
showing pattern
of V cut



Side view showing angles of drill pattern

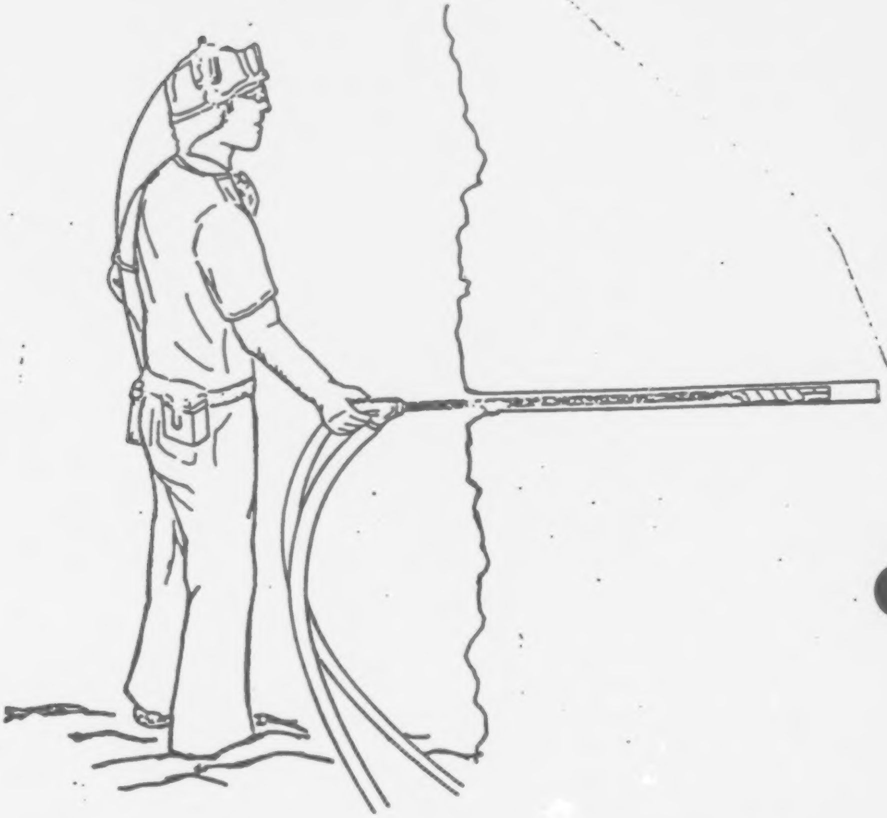

Drilling in a stope (Breasting Down)
Solid Rock
Muck
Muck

-06



Make up primers in prescribed manner.

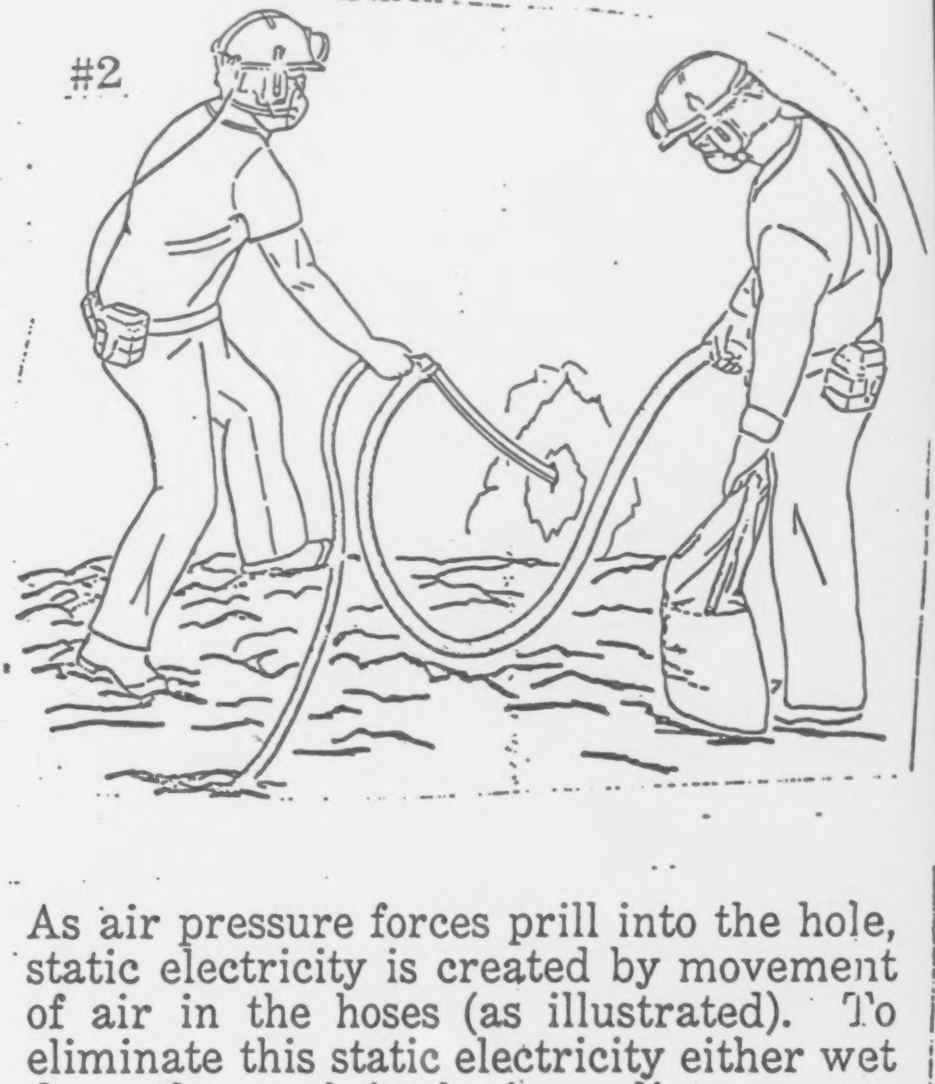
#1



Manually push primer to the bottom of the hole with the lance (**DO NOT** use air to blow primer into the hole).

07 A. Prill AN/FO

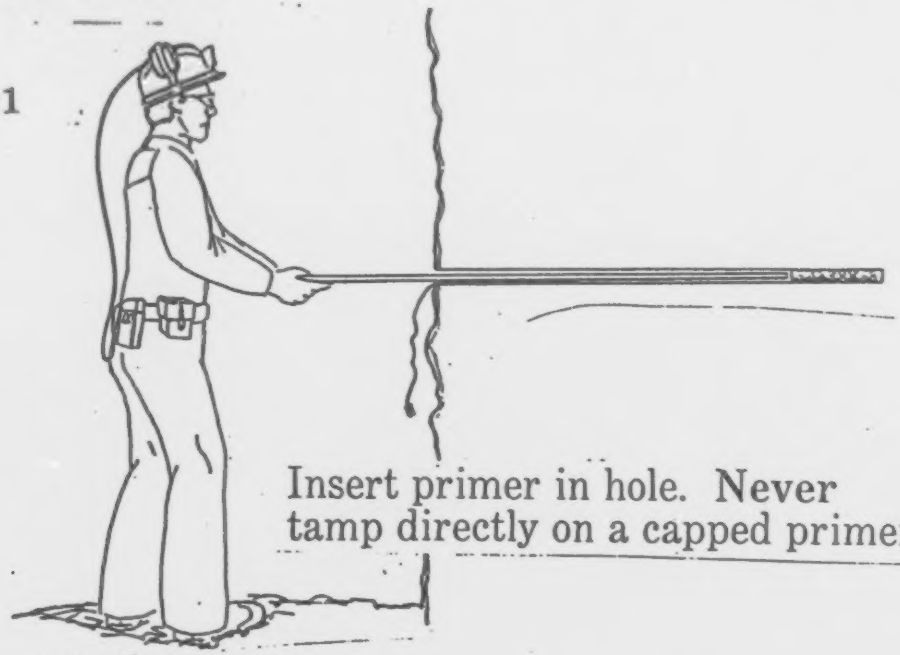
#2



As air pressure forces prill into the hole, static electricity is created by movement of air in the hoses (as illustrated). To eliminate this static electricity either wet down the muck in the immediate area or attach a grounding wire.

07 *B. Stick Powder*

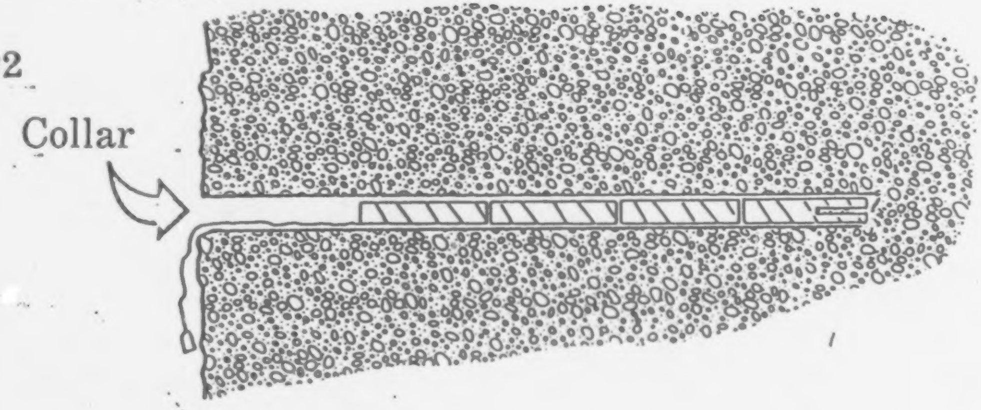
#1



Insert primer in hole. Never tamp directly on a capped primer

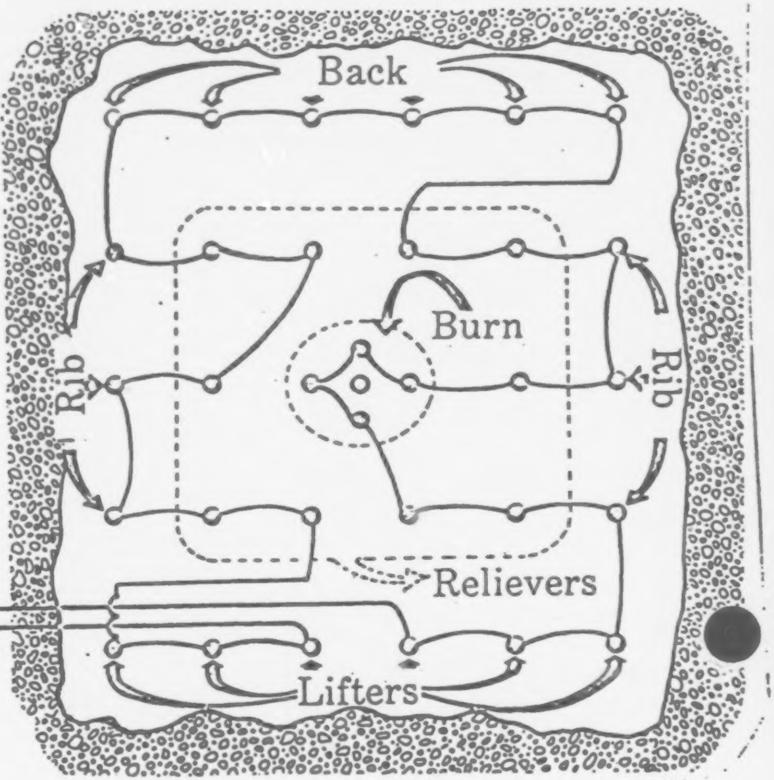
07 *B. Stick Powder*

#2



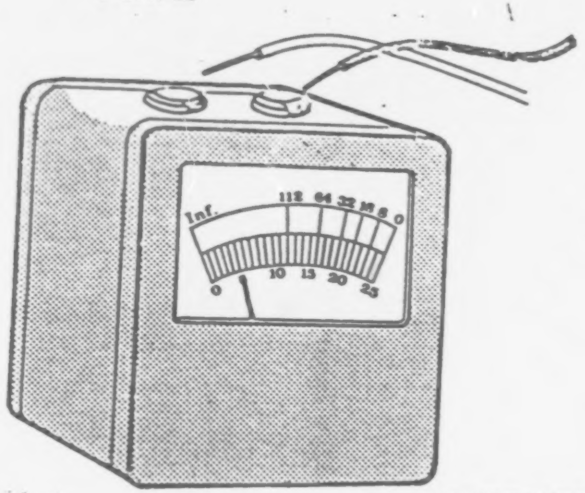
Fill hole with powder until approximately 12-18 inches from collar of hole

-03


Back
Rib
Burn
Rib
Relievers
Lifters

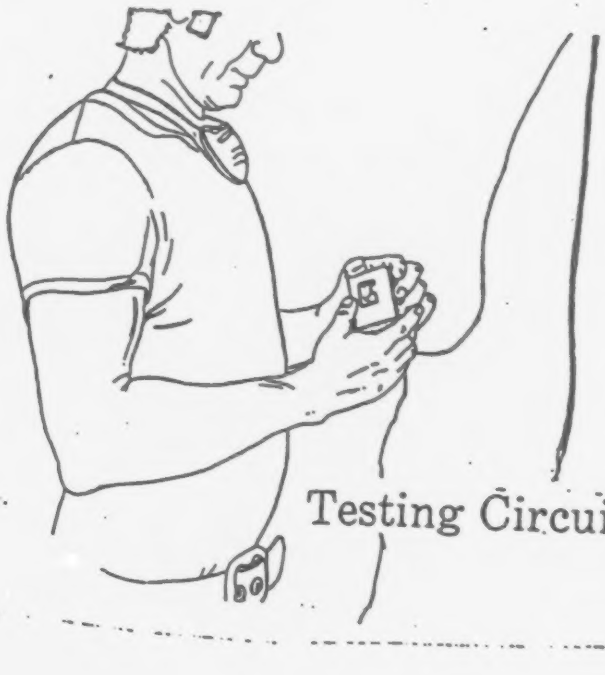
In the illustration above the rounds are wired together forming a complete circuit. This is referred to as a 'wired round'.

-04#1


Inf.
112
64
32
16
8
0
0
10
15
20
25

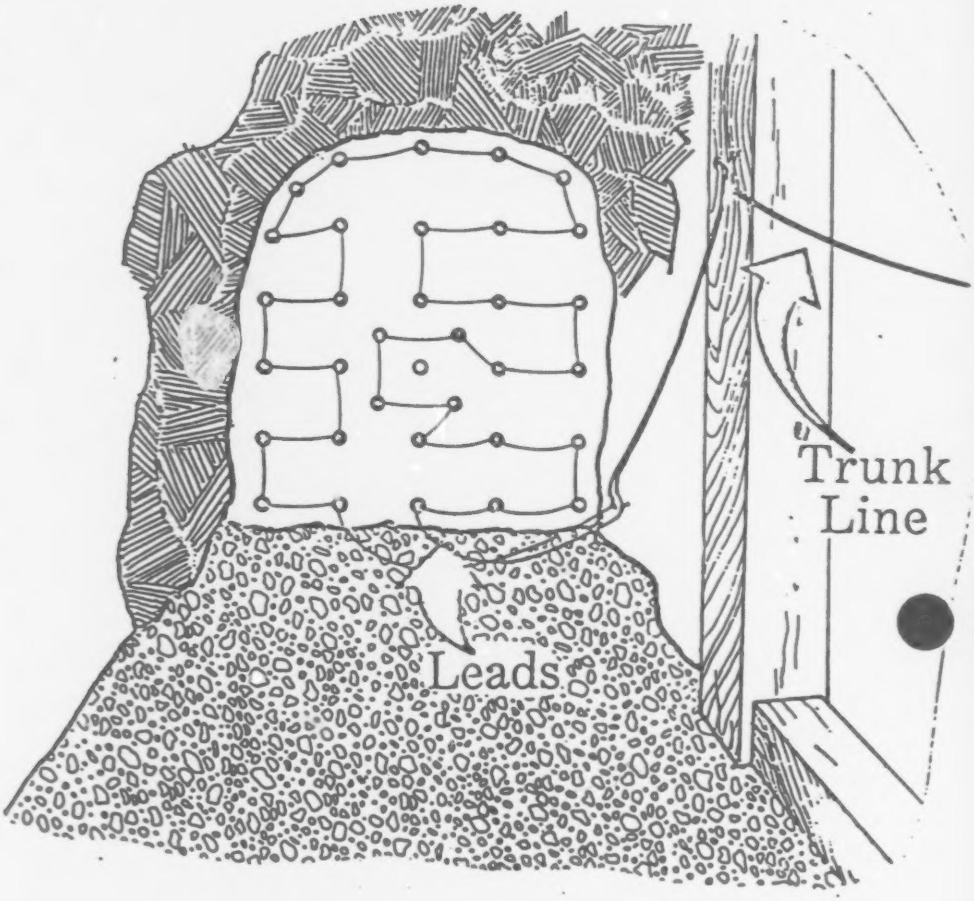
Galvanometer

-04#2

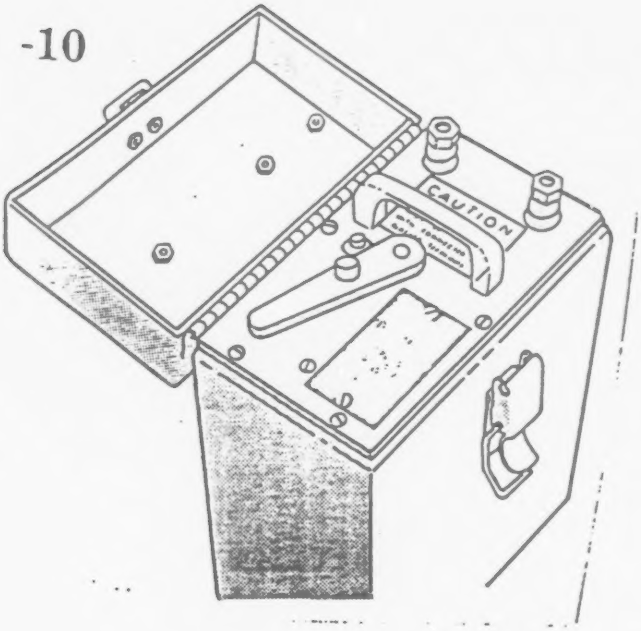


Testing Circuit

-06

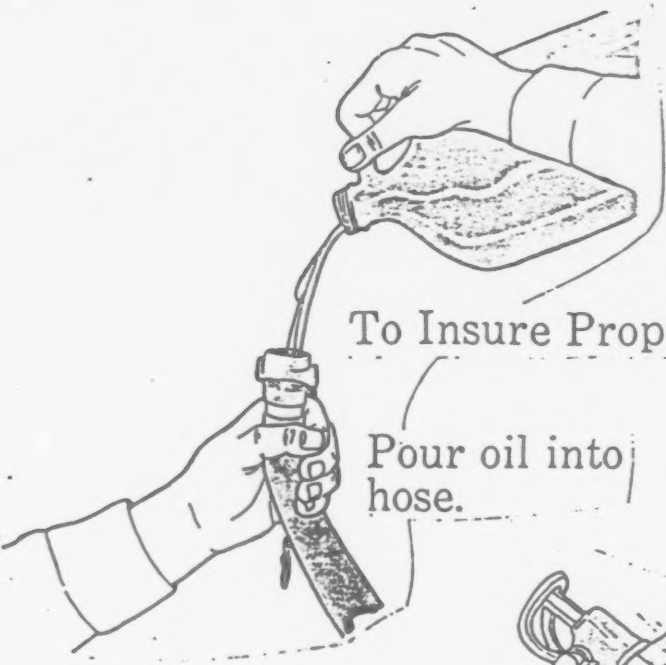

Trunk Line
Leads

-10

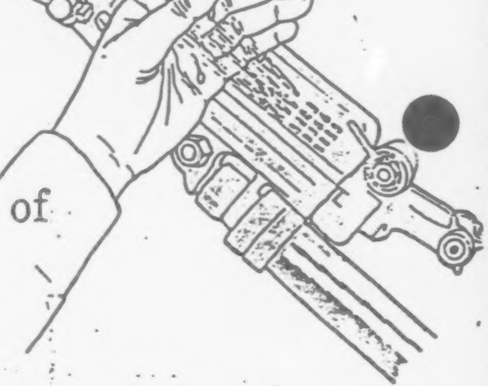


Blasting Box
(Electrical Firing Device)

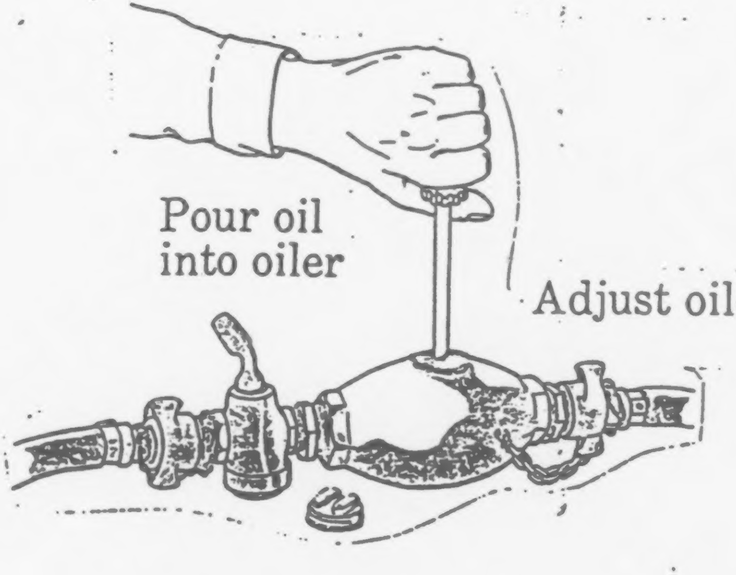
To Insure Proper Lubrication



Pour oil into hose.



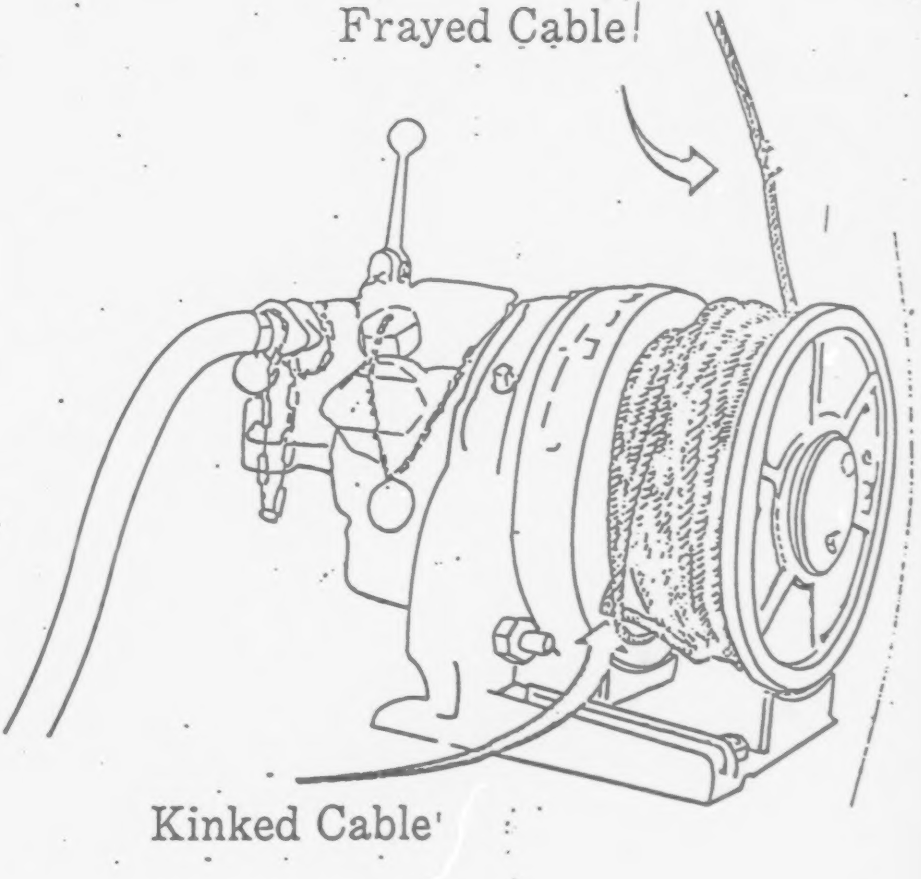
Hold hand in front of rock drill exhaust.

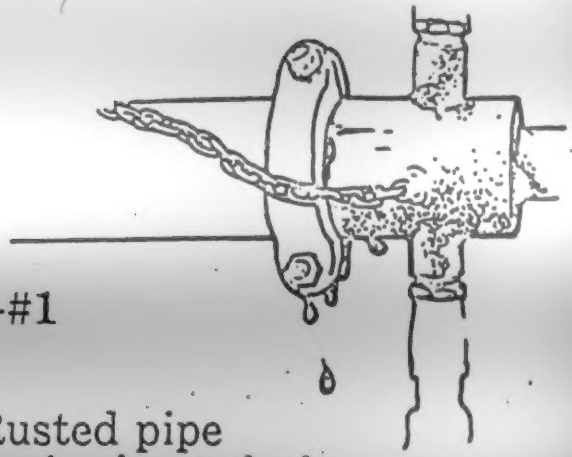


Pour oil into oiler

Adjust oiler.

Damage to Cable

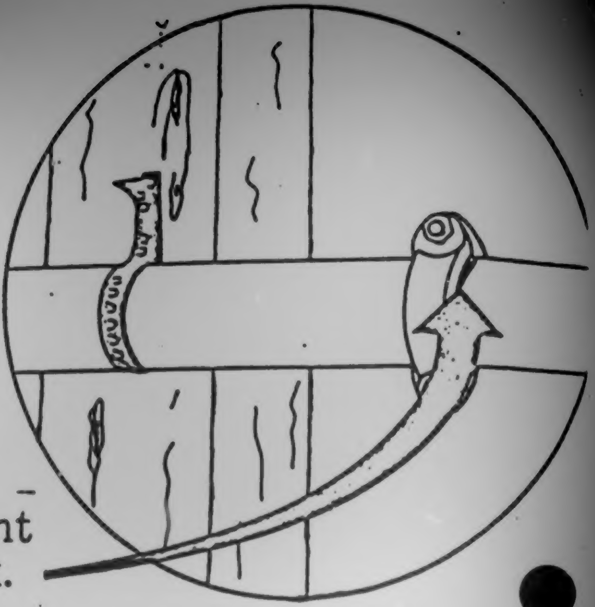

Frayed Cable
Kinked Cable



-#1

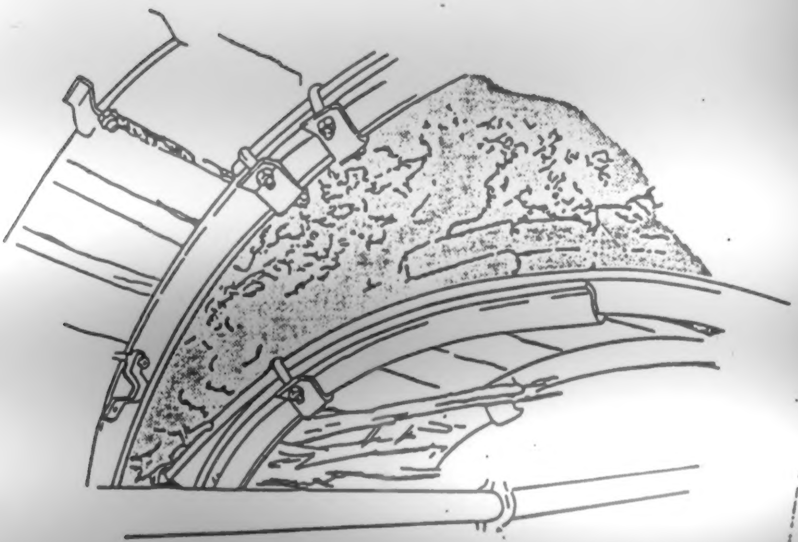
Rusted pipe beginning to leak.

-#2



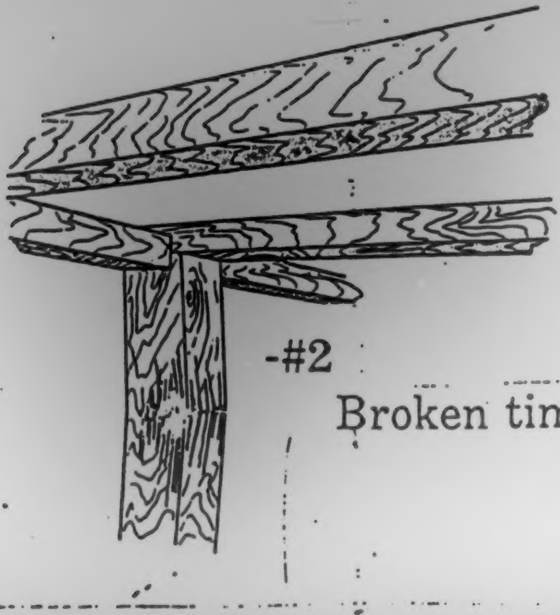
Pipe bent at joint causing air leak.

Ground Support Failures



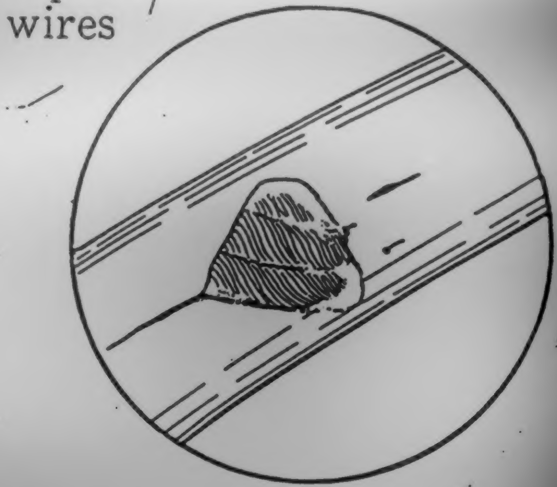
-#1

Slipped Ring Set



-#2

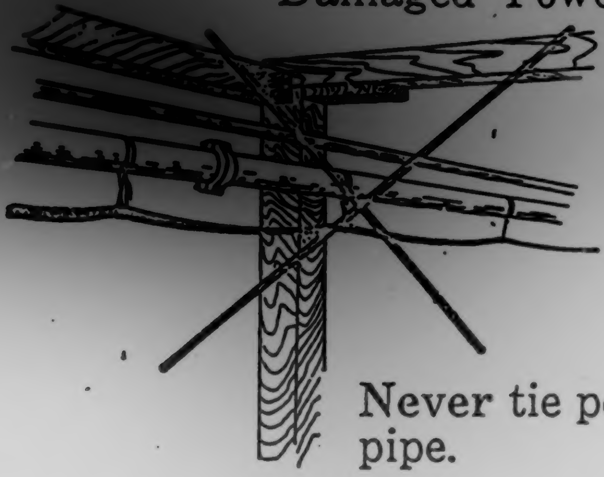
Broken timber



Insulation torn apart exposing bare wires underneath.

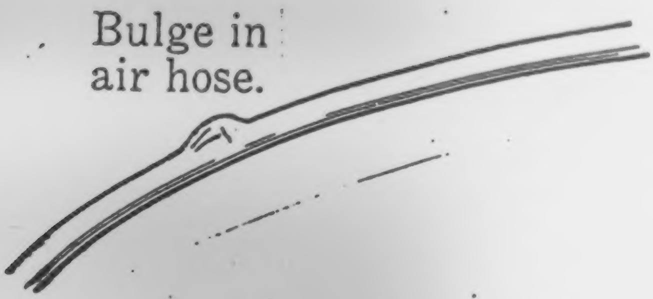
-01

Damaged Power Lines

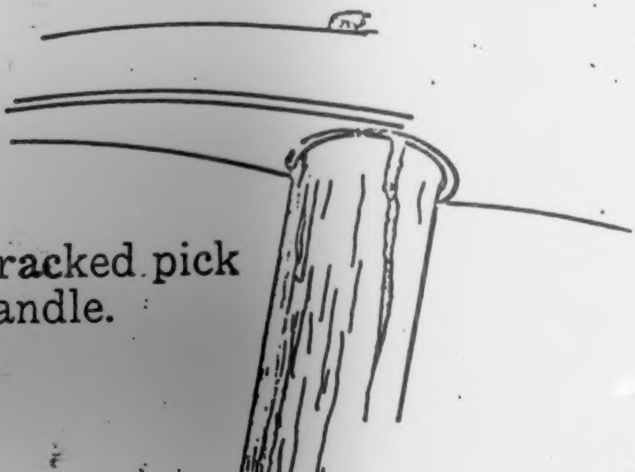


-02

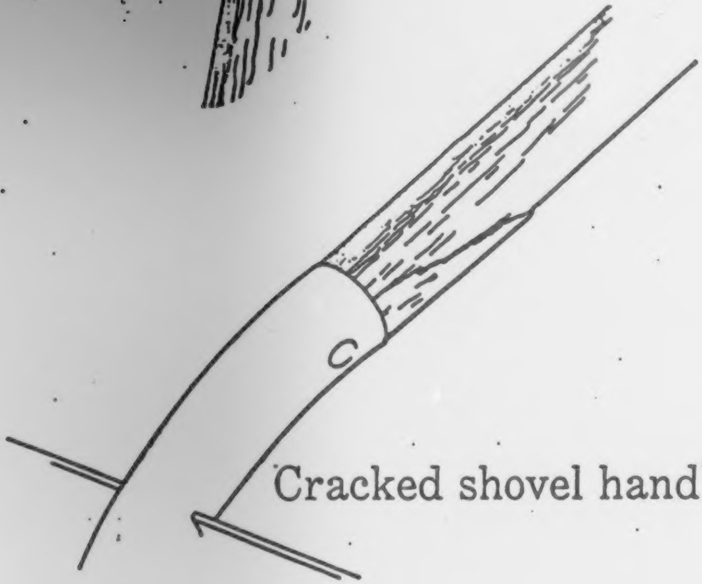
Never tie power line to pipe.



Bulge in air hose.

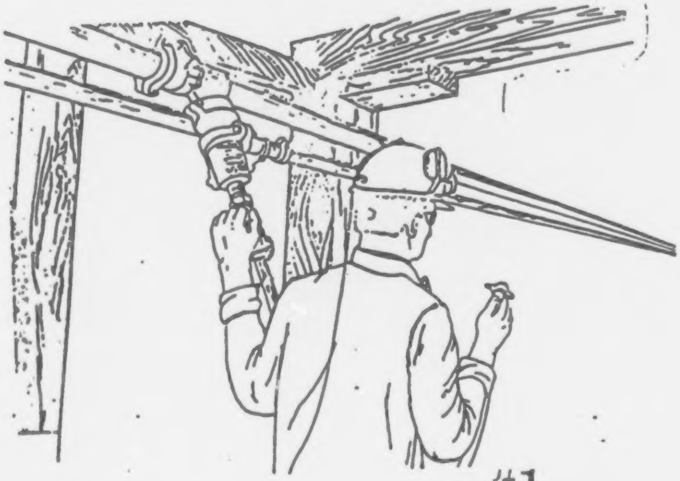


Cracked pick handle.



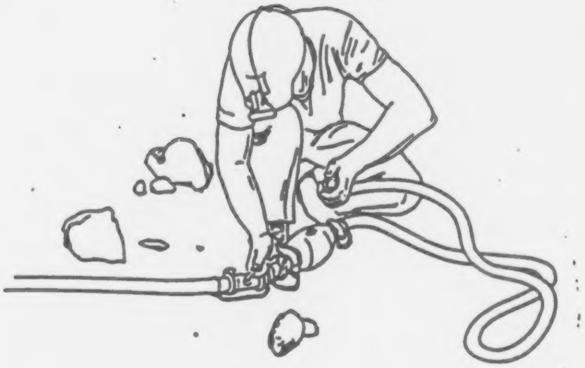
Cracked shovel handle.

Cleans Air & Water Hoses



-#1

Cleaning hos
at header.



-#2

Cleaning hose
at oiler.

SAFE SLUSHING PROCEDURES

This procedure is based on the premise that the miner came into the stope after the blast and commenced slushing out, getting ready for timber.

Logical Step	Operating Hints	Safety Hints
1. The miner must wet down the entire stope in the interest of dust and gas control.		Constantly check back and walls for "tight loose". Tight loose is defined as rock that is too tight to fall out, but is a fall of ground hazard and must be barred down.
2. Miner must bar down the blast area to insure no falls of ground.		See safe barring down procedures.
3. Miner installs 3 eyebolts in face to slush from.	1) Put one eyebolt in each corner and one in the middle of the face. 2) These holes are predrilled when the round is drilled. 3) Note: If holes have been blasted out, may have to drill holes for eyebolt - See drilling.	
4. Lay out slusher cables to work face. Bring sheave block to face.	1) Cables have been taken back to slusher at time of blast. 2) Make sure cables are straight.	Watch for cable barbs in slusher cable. Use gloves to handle all cables with.
5. Hang sheave block in center eyebolt.		

<table>
<tr><th>Logical Step</th><th>Operating Hints</th><th>Safety Hints</th></tr>
<tr><td>6. Miner returns to slusher at the raise.</td><td>He must:
1) Check slusher anchorages.
2) Check slusher screen.
3) Check slusher bonds for correct tightness.
4) Check slusher for proper lubrication.
Note: Avoid "slipping" bands as much as possible.</td><td></td></tr>
<tr><td colspan="3">In the event the slusher bucket becomes overturned, the operator must "tightline" the slusher. Tightlining involves pushing down on both slusher handles and stalling the slusher. This results in making both cables tight. The bucket will raise up and is so counterbalanced that it will right itself.</td></tr>
<tr><td>7. Operator turns on power supply at the switch or valve.</td><td></td><td>He must be careful that no one is in bight of cables. It is recommended that the slusher operator wear safet glasses.
The safety screen must be in place in front of the slusher while operating.</td></tr>
<tr><td>8. Lowering the handle closest to the motor will control the nose cable and will bring the slusher bucket to the raise.</td><td></td><td>Do not let haulback cable run entirely free -- This may require a slight pressure on the haulback bands to control the slack. "Avoid backlash."</td></tr>
<tr><td>9. Lowering the handle away from the motor controls the return or tail cable and will return the bucket to the face.</td><td>Note: Return side of slusher is approximately 1/3 times faster than the nose cable.</td><td>Replace all frayed or worn cables.</td></tr>
</table>

Logical Step	Operating Hints	Safety Hints
10. Commence slushing. Note: This slushing operation assumes a timbering situation: In the case of a cut-and-fill operation, alternate the anchorages for an efficient muck removal.	1) The miner slushes down in the middle of the muck pile. 2) Miner moves sheave block to outer rib and levels muck pile on the right. 3) Miner moves to the left side and completes leveling operation.	The miner must check muck pile constantly to make sure he does not take out too muc muck from one side.
11.	During the timbering operation, the sheave is returned to the middle. Slushing commences at the center with cleanout at the sides.	

MINING TERMS

1. ADIT - A horizontal entrance way into a mine.
2. AIR DOOR - A doorway constructed in a drift or crosscut to control ventilation.
3. AIR LINE - A line carrying compressed air.
4. AIR MOVER - A megaphone shaped device powered by compressed air used for ventilation purposes. (Bazooka)
5. AN/FO LOADER - A pneumatic operated device for loading ammonium nitrate blasting agents into drill holes.
6. APRON - Timber and lagging covering between main timber sets and the ground or brows of working areas.
7. AXE - Hand tool used for splitting or cutting timbers and also used as a light hammer to pound wedges and drive nails.
8. BACK - Any overhead sections of rock or concrete.
9. BACK STOPE - Method of mining where the entire back of a stope is blasted down before the muck is removed.
10. BAD AIR - Air that is deficient of oxygen or contaminated.
11. BALL MILLS - Grinding devices used to grind ore, using a rolling motion of steel balls inside a large circular drum.
12. BATTER - Timbering phrase referring to the angle to which post are set at for maximun strength and support.
13. BAZOOKA - See air mover.
14. BELLS - Signals used to control the movement of conveyances in the shaft.
15. BIT - A removable device attached to the end of drill rods or steel to drill holes in rock.
16. BIT KNOCKER - Device used to remove the bits from the steel.
17. BITCH LINK - A piece of metal with a specially cut hole in it that allows it to be locked into place anywhere along a length of chain. (Used in slushing)
18. BLOCKING - Pieces of wood placed and secured to hold lagging or timber into place, also filling between timber & ground.
19. BLOCK SIGNAL - A warning light to alert a motorman that another train is approaching in the danger zone.
20. BLOW PIPE - A small diameter pipe attached to an air hose used to clean drill holes or clean cars.
21. B.O. - Means BAD ORDER; broken or out-of-order.
22. BOMB - An explosive charge used to free hangups.
23. BOOTLEG - That portion of a drillhole not broken by blasting.
24. BOW SAW - A bow type hand saw used to cut wood.
25. BUBBLE GUM - A booster for Dupont primer.
26. BULKHEAD - A solid or cribbed barrier closing and opening or used for support in large openings.
27. BUZZY - An air stoper type drill used to drill holes upward.
28. CAGE - A conveyances used to transport men or materials in the shaft, similar to an elevator.

ACETYLENE

29. CAGER or CAGE TENDER - A person responsible for operating the cages.
30. CALL SIGNAL - A squawker system used to summon a cage to the level.
31. CAMEL or CAMEL BACK - A dump ramp used for the fifth wheel of a mine car to roll up on to dump the car.
32. CAP - 1) Explosive detonator. 2) A timber on top of two upright timber posts used to support ground or bulkheads.
33. CHEATER - A pipe placed on the end of a wrench to give more leverage.
34. CHOKER - A cable sling.
35. CHUTE - An opening for broken rock or muck to travel to the level below.
36. CHUTE LIP - A structure for loading muck into cars.
37. CLEVIS - A "U" shaped device with a pin for attaching one thing to another.
38. COLLAR - The first level or suface level of a shaft, also the beginning of a drill hole.
39. COLLAR BRACE - A brace placed between two post below a cap in timbering.
40. COMPRESSOR - A machine for compressing air.
41. CORE DRILL or DIAMOND DRILL - Removes cylindrical rock samples for study.
42. CONVEYOR BELT - A rubber coated belt used to transport muck or material.
43. CRIB - Roof support of prop timbers or ties, laid in alternative cross layers.
44. CRIBBING - Manway chute; timber used to construct manway or chute.
45. CRIB PILLARS - Pillar made of timber to support ground.
46. CROSSCUT - A horizontal opening through the rock crossing the bedding of of the ground structure.
47. CRUSHER - A mechanical device for breaking rock.
48. DETONATOR - A blasting cap for detonating explosives.
49. DOG HOLE - Any small opening driven into the rock.
50. DOUBLE JACK - Sledge hammer.
51. DOUBLE SPUD or DOUBLE CONNECTION - (Air or water); A connector with a male thread on each end.
52. DRIFT - A horizontal opening driven into the rock along the rock strata bedding or on the vein structure.
53. DRY - Change room for employees.
54. EXHAUST - The discharge ventilation air from the mine.
55. EXPLOSIVES - Blasting agents (dynamite, water gel, an/fo etc...)
56. EYE BOLT - A piece of threaded rod with a loop on one end. Can be used with an expanding shell to secure into a drill hole for slushing.
57. FACE - The end of any opening driven into the rock.
58. FIN HOE - A hoe shaped scraping device use to rake or drag muck.
59. FIRE EXTINGUISHER - A device (usually dry chemical or CO) to extinguish fires.
60. FIRE HOSE - A hose (1-1/2" or 2-1/2") to extinguish fires.

DYWIDAG - Epoxy type Rock Bolt

61. FISH PLATE - Railroad splice bars for connecting two rails together.
62. FLAT or TIMBER TRUCK - Equipment used to move materials and timber.
63. FLOTATION - Method of separating minerals from the rock by use of chemicals.
64. FROG - Switch plate used to assist rail equipment from one set of rails to another.
65. FUSE - Blasting safety fuse that has a waterproof covering over a black powder train with a burning rate of 40 seconds per foot.
66. GOOSE NECK - A curve pipe on an air drill that the air hose or water hose is attached to.
67. GRIZZLY - A series of rail, strap or angle irons placed in parallel or cross hatched to prevent oversized rock from passing through.
68. GUIDES - Special timber used to guide shaft conveyances in the shaft.
69. HEAD FRAME (GALLOWS FRAME) - The structure on the surface over a shaft supporting the sheave wheels.
70. HEADER or MANIFOLD - The valves and fittings on the main air and water lines.
71. HEADING - A tunnel excavation that is being advanced.
72. HEADING - Blocks used between a timber cap and the ground.
73. HITCH - A notch or ledge carved out of rock into which timber is set.
74. HOIST - The power unit (motor and drums) that controls the shaft conveyances.
75. HOISTING ROPE or CABLE - A stranded wire cable used to connect hoist to conveyances.
76. HOT WIRE (ELECTRICAL) - A charged electrical wire.
77. IGNITOR CORD - A slow burning sparkler type hot wire that is connected to the ends of fuses to ignite them.
78. INTAKE - The fresh air ventilation input to the mine.
79. INVERTED DOOR - Door used above chute door to prevent spillage.
80. JACK HAMMER - A hand held rock drill.
81. JACK LEG or FEED LEG - Air driven rock drill.
82. JIM CROW - Railroad rail bender.
83. JUMBO - A rock drill mounted carrier used for driving horizontal openings in rock.
84. KICK BRACE - A piece of timber going from the sill to a post.
85. KNEE BRACE - A piece of timber going between two posts.
86. LACING - Timber used to divide or block off areas or ground in manways and shafts (usually lagging).
87. LANYARD - Safety rope with hooks on each end.
88. LEAD LINE - Blasting line run from the face to the trunk line.
89. LEVELS - Worked or working areas of a mine off the shaft or winze, also a tool used to level objects.
90. LEYNER - Air driven rock drill on a shell usually used for drifting or longholing.

91. L.H.D. - (Load, haul and dump) A self contained vehicle capable of loading itself, hauling and dumping.
92. LONGHOLE - A hole drilled into rock longer than the normal length of drill steel.
93. MANWAY - Any opening for the express purpose of allowing men to pass to and from any area.
94. MATS - Long steel plates bolted to the rock for support.
95. MEASURING POCKET - A fixed steel bin that holds one skip of muck to prevent overloading skips.
96. MESH - Wire fencing used to hold areas of loose ground.
97. MESSINGER CABLE - A steel cable used to hang electrical wires or vent line on.
98. MINI BLASTER - Mechanism used to detonate a small number of blasting caps.
99. MOTOR - A battery, electric, or diesel powered locomotive to pull or push trains.
100. MOTOR BARN - The charging station for battery locomotives.
101. MUCK - Broken rock, ore or waste.
102. MUCK STICK - Shovel.
103. MUCKER - A machine used to load muck into cars.
104. NON-ELL - A nonelectric, primer ~~cord~~ type of explosive detonator.
105. OILER - Device used to oil and lubricate air motor and air drill parts.
106. ORE PASS - An opening that is used to transport ore by gravity.
107. PICK - A two-pointed tool used for digging.
108. PICKAROON - A lightweight half-pick used for handling timber.
109. PILLAR - A solid block of rock that is left for support as a rock is mined around it.
110. PIN HOLE - A short drill hole used for eye bolts (approx. 2' long).
111. PORTAL - The outside entrance to a tunnel.
112. POST - An upright timber.
113. POWDER - A term used for explosives (dynamite, prill etc.)
114. POWDER MAGAZINE - Storage area for explosives.
115. PRILL - An ammonium nitrate fuel oil blasting agent (i.e., ANFO).
116. PRILL CAN - A device used to hold and feed prill while charging holes.
117. PRILL GUN - A device used to charge a drill hole with prill.
118. PRIMER - A booster or stick of powder with a blasting cap inserted.
119. PRIMER CORD - High speed detonating fuse in cord form.
120. PRIMER MAGAZINE - Storage area for detonators.
121. PULL BOTTLE - An electric spring switch activated by pulling on a cord.
122. RAIL - Steel rails used for railroad tracking.
123. RAISE - An opening driven upward through rock.
124. REFUGE AREA - An area containing air, water, and stopping material where miners can barricade themselves in the event of a catastrophe.

125. RIB - The walls of a drift or crosscut, etc...
126. ROCK BOLTS - Expanding shell bolts used for ground support.
127. ROUND - A series of holes drilled for blasting.

128. SCAB - A piece of short timber nailed to other timber for the support of braces.
129. SCALING BAR - A bar used to remove loose rock from the back, rib or face.
130. SCOOPIES - Load, haul, dump vehicles.
131. SCRUBBER - A device used to clean the exhaust from diesel engines.
132. SERVICE RAISE - [illegible] opening that is used for the passage of men or materials [illegible] one level to another.
133. SHAFT - A vertical or incline access way to a mine.
134. SHOT - Any explosive charge that is being or has been detonated.
135. SHUNTS - A method of neutralizing blasting circuits.
136. SKIP - A bucket used to haul muck up a shaft.
137. SLUSHER - A winch like device used for moving muck.
138. SLUSHER BLOCK - Sheave block used to pass the slusher cable through.
139. SLUSHER BUCKET - A scraper pulled by the slusher to move muck.
140. SLUSHER PIN - An eye bolt anchor to fasten sheave block to the ground.
141. SPIKES - Large nails or square spikes with large heads for tracking.
142. SPITTER CORD - Same as ignitor cord.
143. SPITTING - The act of lighting a fuse.
144. STATION - The area or room on each level at the shaft.
145. STEEL - Rods used for drilling holes in rock.
146. STENCH GAS - A harmless, colorless gas used for emergency evacuation warning system. Smells like rotten garlic.
147. STOP BLOCK - A block placed on the rail that will not allow any equipment to roll.
148. STOPE - An area, varied in length and width where the ore vein is mined upward.
149. STOPER - An air driven rock drill fro drilling holes upward.
150. STULL - A single piece of timber used to prop up a slab or loose ground.
151. SUMP - An area for water collection.
152. SWITCH - That part of a rairoad track that diverts a motor or car from one set of tracks to another.
153. TIMBER SKIP or RAISE SKIP - Conveyance used to carry timber and supplies up a raise timber slide.
154. TIMBER SLIDE - The area of a raise used to pass timber and materials through.
155. TRACK JACK - A jack used to lift rail and ties or rerail derailed track vehicles.
156. TRIP LIGHTS - A flashing light on the end of a train.
157. TUGGER - A small electric or air driven hoist.

Springer Holes - Holes Drilled in Ground and Ends Blasted to relieve Pressure (reduce rockburst)

158. TRUNK LINE - Main blasting line from shot box to work area.

159. VENT FANS - Auxiliary fans directing the flow of the ventilation.

160. VENT LINE - Large pipelines or fabric tubing to carry ventilation air.

161. WATER LINE - A pipeline carrying water.

162. WEDGES - Pieces of tapered wood to tighten timber blockings.

163. WHIP CHECK - A safety rope or device used on connections for air hoses.

164. WHIZ BANG - A piece of pipe with smallholes drilled in it to blow compressed air.

165. WINZE - An internal secondary shaft either vertical or incline.

Concrete Technology Seminar

SPONSORED BY:

[illegible] STATE UNIVERSITY
and
IDAHO CONCRETE &
AGGREGATE PRODUCERS ASSOCIATION

DATE:	November 28, 1989
TIME:	9:30 a.m. - 4:00 p.m.
LOCATION:	Boise State University Student Union Big Four Room
COST:	$10 per person Preregistration form enclosed

TENTATIVE AGENDA

A.M.	Finishing & Curing Quality Concrete Trouble Shooting Hot and Cold Weather Concrete Quality Control
P.M.	Admixtures Use of Fly Ash Certification Program for Testing Architectural Concrete

Applicants are asked to preregister by completing the enclosed application and mailing the application and a check for $10 made payable to Boise State University, Vocational Extended Programs, 1910 University Drive, Boise, ID 83725.

Try to have your registration completed by November 21, 1989, so we can make adequate accommodations for all participants.

For more information contact Don Owen, Statewide Construction Specialist, 334-3216

TABLE OF "TOPICS"

1. MATERIALS IN CONCRETE
2. SPECIFYING THE CONCRETE MIX
3. JOB SITE HINTS FOR CONCRETE CONSTRUCTION
4. HOT WEATHER CONCRETING
5. CURING MATERIALS AND METHODS
6. INSPECTION AND TESTING
7. PLASTIC SHRINKAGE CRACKS
8. COLD WEATHER CONCRETING
9. CAUSES AND CONTROL OF CRACKS IN CONCRETE
10. ADMIXTURES
11. FACTORS INFLUENCING TEMPERATURE OF CONCRETE
12. JOB CONTROL TESTS FOR STRENGTH OF CONCRETE
12A. FIELD TESTING
13. VIBRATION AND REVIBRATION OF CONCRETE
14. WATER FOR MIXING AND CURING CONCRETE
15. DESIGNING CONCRETE FOR SPECIAL USES
16. EFFECT OF VARIOUS SUBSTANCES ON CONCRETE—PROTECTIVE TREATMENTS
17. CONCRETE SURFACE DEFECTS—CAUSES, PREVENTION AND REPAIR
18. EFFECT OF PROLONGED MIXING OF CONCRETE
19. EFFLORESCENCE—CAUSES, REMOVAL AND PREVENTION
20. CONCRETE FORMS AND FORMING
21. REMOVAL OF COMMON STAINS FROM CONCRETE
22. AIR-ENTRAINMENT OF CONCRETE
23. PLACING AND FINISHING CONCRETE
24. FACTORS INFLUENCING STRENGTH OF CONCRETE
25. PUMPING OF CONCRETE
26. SELECTING PROPORTIONS FOR NORMAL WEIGHT CONCRETE
27. INDEX OF STANDARDS
28. PROPERTIES OF CONCRETE AGGREGATES
29. AGGREGATE IN CONCRETE
30. SPECIAL CONCRETES
31. TRANSPORTATION OF CONCRETE
32. PLACEMENT OF CONCRETE
33. READY MIXED CONCRETE REQUIREMENTS FOR PRODUCERS
34. CONTROL JOINTS FOR CONCRETE SLABS
35. FACTORS INFLUENCING QUALITY OF CONCRETE
36. LIGHTWEIGHT AGGREGATE FOR CONCRETE
37. DESIRABLE PROPERTIES OF CONCRETE
38. READY MIXED CONCRETE REQUIREMENTS FOR CONSUMERS
39. NON-FERROUS METALS IN CONTACT WITH CONCRETE
40. COLORING CONCRETE
41. SELECTING PROPORTIONS FOR LIGHTWEIGHT STRUCTURAL CONCRETE
42. REPAIR OF CONCRETE
43. BATCHING OF CONCRETE MATERIALS
44. METHODS FOR ESTIMATING CONCRETE QUANTITIES
45. SET RETARDING AND WATER REDUCING ADMIXTURES FOR CONCRETE
46. LOW PRESSURE STEAM CURING OF CONCRETE
47. TYPES AND USES OF REINFORCEMENT IN CONCRETE
48. GLOSSARY: CEMENT & CONCRETE TECHNOLOGY TERMS, PART 1.
49. GLOSSARY: CEMENT & CONCRETE TECHNOLOGY TERMS, PART 2.
50. LABORATORY TESTING OF CONCRETE AND MATERIALS
51. COOLING CONCRETE
52. SPECIAL CEMENTS
53. PAINTING CONCRETE
54. FORM-RELEASE AGENTS FOR CONCRETE
55. CONCRETE SLAB ON GRADE CONSTRUCTION
56. CONSTRUCTION INDUSTRY ASSOCIATIONS
57. SURFACE DISCOLORATION OF CONCRETE FLATWORK
58. BLEEDING OF CONCRETE

PERHAPS YOU'VE FORGOTTEN...

That if you add only one gallon of water to a yard of properly designed 3000 psi concrete mix:

- You increase the slump about one inch.
- You cut the compressive strength by as much as 200 psi.
- You waste the effect of 1/4 bag of cement.
- You increase the shrinkage potential about 10%.
- You increase the possibility of seepage through the concrete by up to 50%.
- You decrease the freeze/thaw resistance by 20%.
- You decrease the resistance to attack by de-icing salt.
- You lower the quality of the concrete in many other ways.

Moral: If more workability is needed, ask the laboratory which designed the mix to adjust it. It may not need more water.

PERHAPS YOU'VE FORGOTTEN...

That a drop of only 1% in the entrained air (say from 5% to 4%) will almost certainly:

- Reduce the yield by over 1/4 cubic foot per yard, a loss of one cubic yard in a hundred.
- Have the same effect on workability as leaving out about 50 pounds of sand per yard.
- Reduce the slump by about 1/2 inch.
- Increase the water demand by up to 4%, or about one gallon per yard for the average 3000 psi mix.
- Increase the chances for segregation and bleeding.
- Decrease durability by about 10%.
- Decrease resistance to action of de-icing salts.

Moral: Since many factors such as temperature, mixing time, aggregate size and shape, sand gradation, and other things affect the amount of air entrained by a given quantity of air entraining agent, it pays to check the air content frequently and to keep it at the designed level.

Compliments of Concrete Council of St. Louis thru the Concrete Improvement Board of Detroit.

CONCRETE CURING

I. Curing

A. Curing is the last, and most often overlooked step in producing high quality concrete.

B. Lack of proper curing can negate even the most diligent proportioning, batching, placing and finishing.

C. The degree of curing will determine strength, durability, watertightness, abrasion resistance, volume stability, and resistance to freeze/thaw.

D. Proper curing will allow a concrete mix to achieve its maximum potential strength.

E. Curing effects only the top 1/2" of the concrete.

II. What is curing.

A. All reactions which take place as portland cement changes to hardened concrete take place between the portland cement and water. This process is called hydration.

1. Portland cement + water = tobermorite gel

2. Surface area of tobermorite gel is approximately 3,000,000 square centimeters per gram.

3. This enormous surface area provides the forces of surface attraction that cause the particles of gel, sand, and gravel to adhere to each other.

4. If mix water does not remain in the mix long enough to complete the process of hydration, insufficient gel will be produced to properly adhere the components of the mix together, and, therefore, produce the needed strengths.

5. As hydration takes place, the solid matter in the cement paste increases in volume, and will slowly begin to occupy the space originally occupied by the water. (Example: 1 cubic centimeter of cement, when fully hydrated will occupy a volume of 2.2 cubic centimeters.

6. When properly proportioned, a concrete slab can, theoretically, become completely water tight as all voids in the concrete become filled with gel.

7. Hydration is a slow process that is dependent upon both curing time and the amount of excess water included in the mix for workability.

8. With properly cured concrete, voids or capillaries can be minimized, thus determining strength, permeability and durability of any given concrete.

9. Concrete will change volume upon wetting and drying. There are tiny pores between the particles of gel. When water moves out of these pores, the paste will contract. When water moves into these pores, the paste will expand.

10. If concrete is alternately wetted and dried when it is "young" and low in tensile strength, these volume changes can cause cracking. Alternate wetting and drying of concrete at an early age is sometimes more detrimental than no curing at all.

11. If concrete should dry, rewetting will restart the hydration process, however maximum strength cannot be achieved.

III. Methods of curing.

A. Curing is defined by ACI as "the process of maintaining a satisfactory moisture content . . . during hydration of the cementitious materials so that the desired properties of the concrete are developed."

  1. This process can be accomplished in two separate ways.

    a. The application of water to maintain a moist environment.

    b. The use of sealing materials to prevent loss of the mixing water.

B. Maintaining a moist environment.

  1. Ponding

    a. Advantages: * Most efficient hydration

    b. Disadvantages: * Most difficult field application.

      * Areas cannot be open for traffic for duration of curing period.

  2. Fogging or sprinkling

    a. Advantages: * Very efficient hydration.

b. Disadvantages:
- Impractical for field use
- Must be continuous
- Areas cannot be used for traffic for duration of the curing period.
- For use only where run-off will not effect subgrade or other construction activities.

C. Sealing materials

1. Plastic film or waterproof paper

a. Advantages:
- Lightweight
- Reusable

b. Disadvantages:
- May tear
- May be displaced by wind or construction activities
- May stain or discolor colored or architectural concrete

2. Membrane forming curing compounds.

a. ASTM C-309 - Water retention:

5.1 The liquid membrane forming curing compound, when tested as specified herein, shall restrict the water loss to not more than .55 km/m^2 of surface in 72 hours.

IV. Types of curing compounds

A. PW-3: Wax based white pigmented curing compound.

1. For use on sidewalks, highways, driveways, curb & gutter

2. Advantages:
- Economical
- Efficient hydration
- White pigment reflects radiant energy of sun, thus lowering surface temperature of concrete
- Approved by many State Highway Departments

3. Disadvantages:
- Not for interior applications

* Not for use on surfaces that will subsequently receive paint, tile, grout, floor hardeners, or other toppings.

B. LR-151: Clear hydrocarbon resin curing compound

1. For use on sidewalks, floor slabs, walls, cast-in-place concrete.

2. Advantages:
   - * Economical
   - * Efficient hydration
   - * May be used on surfaces that will subsequently receive asphalt, rubber, or linoleum tile, or oil-based paint.

3. Disadvantages:
   - * "Fugitive dye" types for exterior use only
   - * Not for use on floors that will subsequently receive liquid floor hardeners, grouts or cementitious toppings.

C. Promulsion 100 and Promulsion 200: Water emulsified resin based curing compounds.

1. For use in same applications as LR-151 and PW-3 respectively.

2. Advantages:
   - * Same as hydrocarbon resins
   - * More economical
   - * No toxic fumes
   - * Non-flammable
   - * Environmentally safe

3. Disadvantages:
   - * Same as hydrocarbon resins
   - * Can freeze - not recommended for winter use in cold climates

V. Curing and sealing compounds - for wear resistance on sanitation

A. Triple Seal: Chlorinated rubber based curing and sealing compound.

1. For use on warehouse floors, manufacturing plants, garages, parking decks, food processing facilities.

2. Advantages:
   - * Highest water retention of any membrane forming cure.

- * Resistant to many common chemicals.
- * Extremely high abrasion resistance.
- * Compatible with most paints and tile adhesives.

3. Disadvantages:
   - * Yellows slightly with age and exposure to sunlight.
   - * Not for use on surfaces that will subsequently receive liquid floor hardeners, seamless floors, or tile laid in a mortar grout.

B. Acryseal: Acrylic based cure and sealer.

1. For use on colored concrete, architectural concrete, and exposed aggregate.
2. Advantages:
   - * Efficient hydration.
   - * "Water-white" clear, glossy finish.
   - * Good abrasion resistance.
   - * Some chemical resistance.
   - * Compatible with most paints and tile adhesives.
3. Disadvantages:
   - * Not for use on surfaces that will subsequently receive liquid floor hardeners or tile laid in a mortar grout.

C. Promulsion 60 and Promulsion 50AW: Linseed oil emulsion cures and sealers.

1. For use on sidewalks, roads, bridge decks, curbs and gutters, and all exterior concrete exposed to freeze/thaw conditions.
2. Advantages:
   - * Efficient hydration
   - * One-step curing and anti-spalling
   - * Excellent freeze/thaw durability
   - * Excellent resistance to de-icing chemicals
3. Disadvantages:
   - * For exterior use only.

- Not for use on surfaces that will subsequently receive liquid floor hardeners, grouts, or cementitious toppings.

4. Application of Promulsion 60 or Promulsion 50AW retards the set of the surface concrete slightly, thus reducing the stresses that can cause plastic shrinkage cracking.

D. Sodium Silicate "cures" - inadequate water retention, not recommended for use as a curing compound.

VI. Trouble-shooting

A. Plastic shrinkage cracking

1. Caused when rate of evaporation exceeds the rate of bleed.

2. Factors effecting plastic shrinkage cracking.

   a. High temperatures

   b. Low humidity

   c. High wind

3. Steps to help prevent plastic shrinkage cracking:

   a. Erect wind barriers

   b. Provide sun shades

   c. Use fog nozzles to keep humidity high

   d. Apply curing compound as soon as possible after placement.

   e. Consider the use of Promulsion 60 or Promulsion 50AW.

B. Causes of inadequate bond of concrete sealers.

1. Insufficiently cleaned surface.

2. Incompatability of sealer with curing compound.

3. Applied before bleed water off surface.

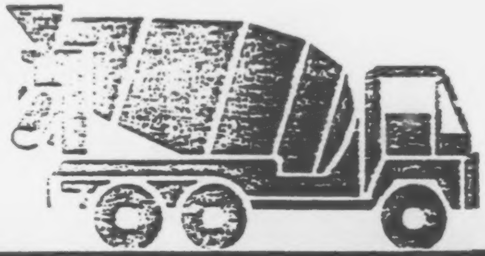
REMEMBER - PROPER CURING OF CONCRETE REDUCES SHRINKAGE, PROTECTS, SEALS, AND ENSURES A HARD, DURABLE SURFACE.

INDEX

CONCRETE IN PRACTICE

WHAT, WHY & HOW?

1. DUSTING CONCRETE SURFACES
2. SCALING CONCRETE SURFACES
3. CRAZING CONCRETE SURFACES
4. CRACKING CONCRETE SURFACES
5. PLASTIC SHRINKAGE CRACKING
6. JOINTS IN CONCRETE SLABS
7. CRACKS IN CONCRETE BASEMENT WALLS
8. "DISCREPANCIES IN YIELD!"
9. LOW CONCRETE CYLINDER STRENGTH
10. STRENGTH OF IN-PLACE CONCRETE
11. CURING IN-PLACE CONCRETE
12. HOT WEATHER CONCRETING
13. CONCRETE BLISTERS
14. FINISHING CONCRETE FLATWORK
15. CHEMICAL ADMIXTURES FOR CONCRETE



CONCRETE IN PRACTICE

CIP 1

What, Why & How? Dusting Concrete Surfaces

1. WHAT Is Dusting?

Chalking or powdering at the surface of a concrete slab is called dusting. The characteristics of such surfaces are:

a. They powder under any kind of traffic

b. They can be easily scratched with a nail or even by sweeping.

2. WHY Do Concrete Floors Dust?

A concrete floor dusts under traffic because the wearing surface is weak. This weakness can be caused by:

a. Any finishing operation performed while bleed water is on the surface. Working this bleed water back into the top ¼ inch of the slab produces a very high water-cement ratio and, therefore, a low strength surface layer.

b. Placement over a nonabsorptive subgrade or polyethylene. This reduces normal absorption by the subgrade, increases bleeding and, as a result the risk of surface dusting.

c. Insufficient or no curing. This omission often results in a soft surface skin which will easily dust under foot traffic.

Dusting concrete surface.

d. Floating and/or troweling of condensation moisture from warm humid air on cold concrete. In cold weather the concrete sets slowly, in particular cold concrete in basement floors. If the humidity is relatively high water will condense on the freshly placed concrete which, if troweled into the surface, will cause dusting.

e. Inadequate ventilation in close quarters. Carbon dioxide from open salamanders, gasoline engines or generators, power buggies or mixer engines may cause a chemical reaction known as carbonation which greatly reduces the strength and hardness of the concrete surface.

f. Inadequate protection of freshly placed concrete from rain, snow or drying winds.

3. HOW To Prevent Dusting

a. In general, use concrete with a moderate slump (not over 5 inches). However, concrete with a higher slump (up to 6 or 7 inches) may be used providing the mixture is designed to produce the required strength without excessive bleeding and/or segregation. The higher slump levels can be used in hot weather when setting time is reduced and less time is available for bleeding. In cold weather delayed setting will increase bleeding and require use of lower slump. Concrete having a low water-cement ratio and moderate slump helps produce a strong wear resistant surface.

b. *NEVER* sprinkle or trowel dry cement into the surface of plastic concrete to absorb bleed water. Remove bleed water by dragging a garden hose across the surface. Excessive bleeding of concrete can be reduced by using air entrained concrete, by modifying mix proportions and by reducing setting time.

c. *DO NOT* perform any finishing operations with water present on the surface. Bleed water can be worked into surface fines from delayed bullfloating. Initial screeding must be promptly followed by bullfloating.

d. Avoid direct placement of concrete on polyethylene or nonabsorptive subgrades. Place 1 to 2 inches of damp sand over polyethylene or nonabsorptive subgrade prior to concrete placement. On absorptive subgrades dampen the surface just prior to concrete placement.

e. Provide proper curing by using liquid membrane curing compound or by covering the surface with wet burlap. Protect young concrete from the environment.

f. When placing concrete in cold weather use warm concrete as well as an accelerator.

4. HOW To Repair Dusting

a. To minimize or eliminate dusting, apply a chemical floor hardener such as zinc or magnesium flurosilicate in compliance with manufacturer's directions on thoroughly dried concrete. If dusting persists, use hardeners with cementitious properties of their own, such as latex formulations, boiled linseed oil or paint.

b. In severe cases, a serviceable floor can be obtained by wet-grinding the top surface, followed by properly bonded placement of a topping course. If this is not practical, installation of a floor covering, such as carpeting or vinyl tile covering is the least expensive solution to severe dusting.

References:

1. "Job Conditions Affect Cracking and Strength of Concrete in Place." by Richard H. Campbell et al, ACI Journal, January 1976.
2. "Recommended Practice for Concrete Floor and Slab Construction." ACI 302-69.
3. "Causes of Floor Failures." by A.T. Hersey, ACI Journal, June 1973.
4. "Slab Construction Practices Compared by Wear Test." by Blake Fentress, ACI Journal, July 1973.
5. "Cement Mason's Manual for Residential Construction." Portland Cement Association.
6. "The Effect of Various Surface Treatments, Using Zinc and Magnesium Flurosilicate Crystals on Abrasion Resistance of Concrete Surfaces." Concrete Laboratory Report No. C-819, U.S. Bureau of Reclamation.

Follow These Rules to Prevent Dusting

a. Use moderate slump concrete
b. Finish properly
c. Cure properly

NRMCA

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A

© NATIONAL READY MIXED CONCRETE ASSOCIATION 1978

10M/3-87R

CONCRETE IN PRACTICE

CIP 2

What, Why & How? Scaling Concrete Surfaces

1. WHAT is Scaling?

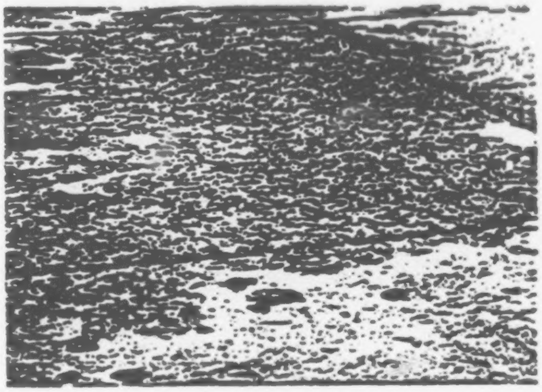
When concrete scales from freezing and thawing the finished surface flakes or peels off. Generally it starts as localized small patches which later may merge and extend to expose large areas. Light scaling does not expose the coarse aggregate. Moderate scaling exposes the aggregate and may involve loss of up to 1/8 to 3/8 inch of the surface mortar. In severe scaling more surface has been lost and the aggregate is clearly exposed and stands out.

(Note—Occasionally concrete peels or scales in the absence of freezing and thawing. This type of scaling is not covered in this CIP. Often this is due to the early use of a steel trowel (see reference 6) or finishing while bleed water is on the surface.)

2. WHY Do Concrete Surfaces Scale?

Concrete slabs exposed to freezing and thawing in the presence of moisture and/or deicing salts are susceptible to scaling. Most scaling is caused by:

a. The use of *non-air-entrained concrete* or too little entrained air. Adequate air entrainment is necessary for protection against freezing and thawing damage. However, even air entrained concrete will scale if other precautions are not observed.



Scaling concrete surface.

b. Application of calcium or sodium chloride deicing salts. If other salts such as ammonium sulfate or ammonium nitrate are used they can cause scaling as well as inducing severe chemical attack of the concrete surface.

c. Any finishing operation performed while bleed water is on the surface. If bleed water is worked back into the top ¼ inch of the slab a very high water-cement ratio and, therefore, a low strength top surface layer is produced.

d. Insufficient or no curing. This omission often results in a weak surface skin which will scale if it is exposed to freezing and thawing in the presence of moisture and de-icing salts.

3. HOW to Prevent Scaling

a. To prevent scaling the use of air-entrained concrete is a must. Severe exposures require air contents of 6 to 7 percent in freshly mixed concrete made with ¾ inch or 1 inch aggregate. In moderate exposures where deicing salts will not be used 4 to 6 percent air will be sufficient. Air-entrained concrete having a low water-cement ratio and moderate slump (up to 5 inches) helps produce a strong wear resistant surface.

b. *DO NOT* use deicing salts, such as calcium or sodium chloride, on new or recently placed concrete. Use clean sand for traction. *Never use ammonium sulfate or ammonium nitrate as a deicer;* these are chemically aggressive and destroy concrete surfaces. Poor drainage which permits water or salt and water to stand on the surface for extended periods of time greatly increases the severity of the exposure and causes scaling. (This is often noticed in gutters and sidewalks where the snow from plowing keeps the surface wet for long periods of time.) Light applications of salts can be more damaging than heavy applications; even salts carried on cars may cause severe scaling of newly placed driveways.

c. Provide proper curing by using liquid membrane curing compound or by covering the surface of freshly placed slab with wet burlap. Curing insures proper combination of cement with water known as hydration which allows the concrete to achieve its highest potential strength.

d. *DO NOT* perform any finishing operations with water present on the surface. Initial screeding must be promptly followed by bullfloating.

e. Protect concrete from the harsh winter environment. It it important to protect the young concrete from becoming saturated with water prior to freeze and thaw cycles of the winter months. Seal the surface with a 50/50 mixture of boiled linseed oil and mineral spirits. The concrete should be reasonably dry prior to the application of a sealer. Late summer is the ideal time for surface treatment. The sealer can be sprayed on or brushed on the surface of the concrete. *CAUTION:* Linseed oil will darken the color of the concrete and care should be taken to apply it uniformly.

4. HOW to Repair Scaled Surfaces

The repaired surface will only be as strong as the base surface to which it is bonded. Therefore, the surface to be repaired should be free of dirt, oil or paint and most importantly it must be sound. To accomplish this use a hammer and chisel, sandblasting or jack hammer to remove all weak or unsound material. The clean, rough, textured surface is then ready for a thin bonded resurfacing such as:

a. Portland cement concrete resurfacing
b. Latex modified concrete resurfacing

References

1. "Durability of Concrete in Service," ACI 201, Chapter 2, ACI Manual of Concrete Practice, Part 1.
2. "Scaled Concrete," by Fred F. Bartel, Tews Lime and Cement Company.
3. "Problems of Ice Removal from Pavements," by William E. Dickinson, Calcium Chloride Institute, NRMCA Publication No. 98.
4. "Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals," National Cooperative Highway Research Program Report No. 16.
5. "Recommended Practice for Concrete Floor and Slab Construction," ACI 302, Manual of Concrete Practice, Part 1.
6. "An Unusual Case of Surface Deterioration on a Concrete Bridge Deck," by John Ryell, ACI Journal, April 1965.

Follow These Rules to Prevent Scaling

1. For moderate to severe exposures, use air-entrained concrete of medium slump (3–5 in.) and cure properly.
2. If late Fall placement cannot be avoided in moderate to severe climates:
    a. Do not use deicers for first winter.
    b. Seal surface with boiled linseed oil.
3. Use correct timing for all finishing operations.
4. Select the proper mix to match placing conditions. Specify air-entrained concrete. Use an accelerator and lower slump in cold weather.

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

616

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1978

20M/3-78
10M/9-84R

CONCRETE IN PRACTICE

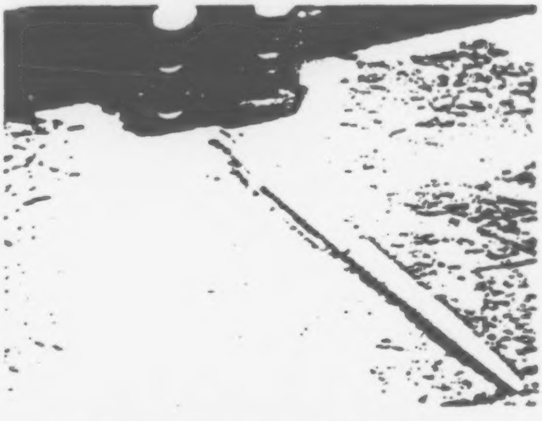
CIP
3

What, Why and How? Crazing Concrete Surfaces

1. WHAT is Crazing?

Crazing is the development of a network of fine random cracks or fissures on the surface of concrete or mortar caused by shrinkage of the surface layer. These cracks are rarely more than ⅛ inch deep and are more noticeable on steel-troweled surfaces. The irregular hexagonal areas enclosed by the cracks are typically no more than 1½ inch across and may be as small as ½ or ⅜ inch in unusual instances. Generally, craze cracks develop at an early age and are apparent the day after placement or at least by the end of the first week. Often they are not readily visible until the surface has been wetted and it is beginning to dry out.

Crazing cracks are sometimes referred to as shallow map or pattern cracking. They do not affect the structural integrity of concrete and rarely do they affect durability or wear resistance. However, crazed surfaces can be unsightly. They are particularly conspicuous and unsightly on concrete which contains calcium chloride.



Crazing Concrete Surface (Dampened)

2. WHY Do Concrete Surfaces Craze?

Concrete surface crazing usually occurs because one or more of the rules of "good concrete practice" were not followed. The most frequent violations are:

a. Poor or inadequate curing. Intermittent wet curing and drying or even the delayed application of curing will permit rapid drying of the surface and provoke crazing.

b. Too wet a mix, excessive floating, the use of a jitterbug or any other procedures which will depress the coarse aggregate and produce an excessive concentration of cement paste and fines at the surface.

c. Finishing while there is bleed water on the surface or the use of a steel trowel at a time when the smooth surface of the trowel brings up too much water and cement fines. Use of a bullfloat or darby while bleed water is on the surface will produce a high water-cement ratio weak surface layer which will be susceptible to crazing, dusting and other defects.

d. Sprinkling cement on the surface to dry up the bleed water is a frequent cause of crazing surfaces. This concentrates fines on the surface.

e. Occasionally carbonation of the surface causes crazing. Carbonation is a chemical reaction between cement and carbon dioxide or carbon monoxide from unvented heaters. In such instances the surface will be soft and will dust as well.

3. HOW to Prevent Crazing

a. To prevent crazing start curing the concrete as soon as possible. The surface should be kept wet by either flooding the surface with water or, covering the surface with damp burlap and keeping it continuously moist for a minimum of 3 days or, spraying the surface with a liquid membrane curing compound. Curing retains the moisture required for proper combination of cement with water. This chemical reaction between cement and water is called hydration.

b. Use moderate slump (3 to 5 inches), air entrained concrete. Higher slump (up to 6 or 7 inches) can be used providing the mixture is designed to produce the required strength without excessive bleeding and/or segregation. Air entrainment helps to reduce the rate of bleeding of fresh concrete and thereby reduces the chance of crazing.

c. *NEVER* sprinkle or trowel dry cement or a mixture of cement and fine sand into the surface of the plastic concrete to absorb bleed water. Remove bleed water by dragging a garden hose across the surface. *DO NOT* perform any finishing operation while bleed water is present on the surface.

d. Dampen the subgrade prior to concrete placement to prevent it absorbing too much water from the concrete. If an impervious membrane, such as polyethylene, is required on the subgrade cover it with 1 to 2 inches of damp sand to reduce bleeding.

References

1. "Recommended Practice for Concrete Floor and Slab Construction," ACI 302, Manual of Concrete Practice, Part 1.
2. "Slab Construction Practices Compared by Wear Tests," by L. Blake Fentress, ACI Journal, July 1973.
3. "How to Prevent Concrete Slab Surface Defects," Portland Cement Association (IS 777.01T).
4. "Solutions to the Problems of Scaling, Crazing, Dusting of Concrete Slabs," Modern Concrete, November 1963.

Follow These Rules to Prevent Crazing

1. Use moderate slump (3-5 inch) air entrained concrete.
2. Finish properly:
   a. Remove bleed water before performing any finishing operations. *DO NOT* dust any cement onto the surface to absorb bleed water.
   b. Avoid excessive manipulation of the surface, which can depress the coarse aggregate, increase the cement paste at the surface, and increase the water-cement ratio at the surface.
   c. Delay steel troweling until water sheen has disappeared from the surface.
3. Cure properly as soon as finishing has been completed.

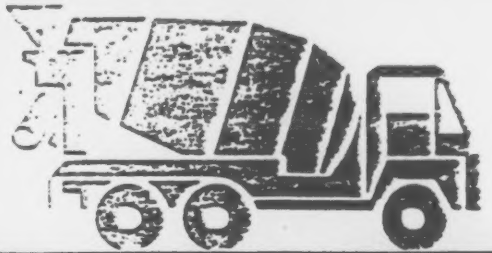
NRMCA

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U S A

NATIONAL READY MIXED CONCRETE ASSOCIATION, 1978

20M/8-78
10M/4-86R



CONCRETE IN PRACTICE

CIP
4

What, Why & How? Cracking Concrete Surfaces

1. WHAT are Some Forms of Cracks?

Concrete, like other construction materials, contracts and expands with changes in moisture content and temperature and deflects depending on load and support conditions. When provisions for these movements are not made in design and construction, then cracks can occur. Some forms of common cracks are:

Figure A—Plastic Shrinkage Cracking (See CIP-5)

Figure B—Cracks Due to Improper Jointing (See CIP-6)

Figure C—Cracks Due to Continuous External Restraint (Example—Cast in place wall restrained along bottom edge of footing)

Figure D—Basement Floor Cracks (See CIP-6)

Figure E—D-Cracks from Freezing and Thawing

Figure F—Craze Cracks (See CIP-3)

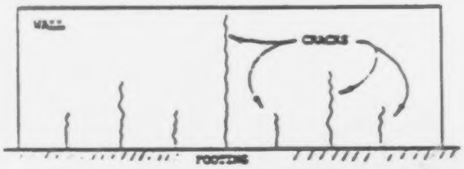
Figure G—Settlement Cracks

Cracks rarely affect structural integrity. Most random individual cracks look bad and although they permit entrance of water they do not lead to progressive deterioration. They are simply unsightly. Closely spaced pattern cracks or D-cracks due to freezing and thawing are an exception and may lead to ultimate deterioration.

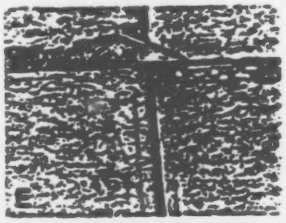
A

B

C



D



2. WHY Do Concrete Surfaces Crack?

The majority of concrete cracks usually occur due to improper design and construction practices, such as:

a. Omission of isolation and control joints and improper jointing practices.

b. Improper subgrade preparation.

c. The use of high slump concrete or addition of water on the job.

d. Improper finishing.

e. Inadequate or no curing.

3. HOW to Prevent or Minimize Cracking

All concrete has a tendency to crack and it is not possible to consistently produce completely crack-free concrete. However, cracking can be reduced and controlled if the following basic safeguards are observed:

a. *Subgrade and Formwork.* All top soil and soft spots should be removed. Regardless of its type, the soil beneath the slab should be compacted soil or granular fill, well compacted by rolling, vibrating or tamping. The slab and, therefore, the subgrade should be sloped for proper drainage. Smooth, level subgrades help prevent cracking. All formwork must be constructed and braced so that it can withstand the pressure of the concrete without movement. Polyethylene vapor barriers increase bleeding and greatly increase cracking of high slump concrete. Cover the vapor barrier with 1 to 2 inches of damp sand to reduce bleeding. Immediately prior to concrete placement, dampen the subgrade, formwork, and the reinforcement.

b. *Concrete.* In general, use concrete with a moderate slump (not over 5 inches). Avoid retempering. If higher slump, up to 7 inches, is to be used, proportions will have to be changed and special mixtures developed to avoid excessive bleeding, segregation and low strength. Specify air-entrained concrete for outdoor slabs subjected to freezing weather. (See CIP-2)

c. *Finishing.* DO NOT perform finishing operations with water present on the surface. Initial screeding must be promptly followed by bullfloating. For better traction on exterior surfaces use a broom finish. If evaporation is excessive reduce it by some means to avoid plastic shrinkage cracking. Cover the concrete with wet burlap or polyethylene sheets in between finishing operations if conditions are severe.

d. *Curing.* Start curing as soon as possible. Spray the surface with liquid membrane curing compound or cover it with damp burlap and keep it moist for at least 3 days. A second application of curing compound the next day is a good quality assurance step.

e. *Joints.* Provisions for contraction or expansion movements due to temperature and/or moisture change should be provided with construction of control joints by sawing, forming or tooling a groove about ¼ the thickness of the slab, no further apart than 30 times the thickness. Often closer spacing of control joints will be necessary to avoid long thin areas. The length of an area should not exceed about 1.5 times the width. Isolation joints should be provided whenever restriction to freedom of either vertical or horizontal movement is anticipated; such as where floors meet walls, columns, or footings. These are full-depth joints and are constructed by inserting a barrier of some type to prevent bond between the slab and the other elements.

f. *Cover Over Reinforcement.* Cracks in reinforced concrete caused by expansion of rust on reinforcing steel should be prevented by providing sufficient concrete cover (at least 2 inches) to keep salt and moisture from contacting the steel.

References

1. ACI Standard Recommended Practice for Concrete Floor and Slab Construction, ACI 302, ACI Manual of Concrete Practice, Part 1, 1978.
2. "Causes of Floor Failures," by A. T. Hersey, ACI Journal, June 1973.
3. "Cracks in Concrete: Causes, Prevention, Repair," A collection of articles from Concrete Construction Magazine, June 1973.
4. "Why and How: Joints for Floors on Ground," Report No. RP026.01B, Portland Cement Association, Skokie, Ill.

Follow These Rules to Minimize Cracking

1. Design the members to handle all anticipated loads.
2. Provide proper control and isolation joints.
3. In slab-on-grade work, prepare a stable subgrade.
4. Place and finish according to established rules.
5. Protect and cure the concrete properly.

NRMCA

Technical Information prepared by:

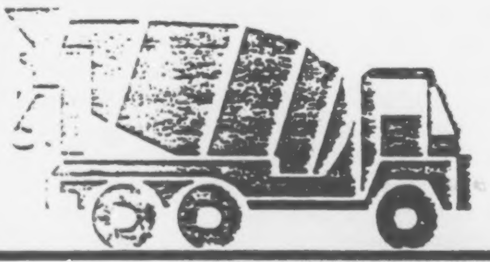
National Ready Mixed Concrete Association

900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1978

10M/3-87R



CONCRETE IN PRACTICE

CIP 5

What, Why & How? Plastic Shrinkage Cracking

1. WHAT is Plastic Shrinkage Cracking?

Plastic shrinkage cracks are cracks that appear on the surface of a freshly placed concrete slab during finishing operation or soon after. These cracks are usually parallel to each other on the order of 1 to 3 feet apart, and 1 to 2 inches deep; and rarely do they intersect the perimeter of the slab.

Plastic shrinkage cracks rarely impair the strength of concrete floors and pavements, nevertheless, they are unsightly. The development of these cracks can be minimized if appropriate measures are taken prior to and during construction.

(Note: Plastic shrinkage cracks should be distinguished from other early or pre-hardening cracks caused by settlement of the concrete on either side of a reinforcing bar due to bleeding and resistance to settlement over the bar or because of formwork movement. See Reference 6.)

Plastic Shrinkage Cracks

2. WHY Do Plastic Shrinkage Cracks Occur?

The most common explanation for the occurrence of plastic shrinkage cracking is that the rate of evaporation of surface moisture exceeds the rate at which it is being replaced by bleed water. This causes shrinkage of the surface while the underlying plastic concrete remains the same volume. However, some field investigations have shown that the bleeding characteristics of concrete do not have a major influence on plastic shrinkage cracking. There is evidence that all cement paste shrinks during early hydration which produces very small micro cracks. When the rate of evaporation is high and the concrete has enough strength (or stiffness) to cause horizontal shrinkage the normal microcracking tendency is accentuated and noticeable plastic cracking may result. Following are examples of weather conditions which increase the rate of evaporation and, therefore, the risk of plastic shrinkage cracking.

a. Decrease in relative humidity. Changes in relative humidity have pronounced effects on the rate of evaporation. If the relative humidity changes from 90 percent to 50 percent the rate of evaporation is increased by five times.

b. Increase in wind velocity. When wind blows across the surface of concrete during placement and finishing the evaporation of surface moisture will increase. For example an increase in wind speed from 0 to 10 mph will quadruple rate of evaporation.

c. Temperature. If the temperature of both the concrete and the surrounding air rises, the rate of evaporation will increase. For instance, when the temperature of both concrete and air increases from 50 to 70° F the rate of evaporation of water from the surface can double.

d. Rapid evaporation and plastic cracking may also occur when the temperature of the concrete is significantly higher than the air temperature (and the "dew point" temperature). This can occur in cold weather with heated concrete even when the humidity is high and the concrete is placed indoors where the wind velocity is negligible.

3. HOW to Minimize Plastic Shrinkage Cracks

Attempts to eliminate plastic shrinkage cracking by increasing the bleeding characteristics of the concrete either by increasing slump or by using different cement or aggregate or by addition of a retarder have not been found to be consistently effective. To reduce plastic shrinkage cracking it is important to recognize ahead of time, before placement, when weather conditions may occur that are conducive to plastic shrinkage cracking. Precautions can then be taken to minimize its occurrence. They are:

a. Have proper manpower, equipment, and supplies on hand so that the concrete can be placed and finished promptly. If delays occur, cover the concrete with wet burlap, polyethylene sheeting or building paper between finishing operations. Some contractors find that plastic shrinkage cracks can be prevented in hot dry climates by spraying a chlorinated rubber curing compound, or monomolecular film, on the surface behind the screeding operation and before floating or troweling.

b. Start curing the concrete as soon as possible. Spray the surface with liquid membrane curing compound or cover the surface with wet burlap and keep it continuously moist for a minimum of 3 days.

c. If concrete is to be placed on a dry subgrade or on previously placed concrete, the subgrade or the concrete base should be thoroughly dampened. The formwork and reinforcement should also be dampened.

d. The use of vapor barriers under a slab on grade greatly increases the risk of plastic shrinkage cracking. If a vapor barrier is required cover it with a 2-inch layer of damp sand.

e. In the very hot and dry periods use fog sprays. Erect temporary windbreaks to reduce the wind velocity over the surface of the concrete and if possible also provide sun shades to control the surface temperature of the slab. If conditions are critical, schedule placement to begin in the late afternoon or early evening.

References

1. ACI Standard Recommended Practice for Hot Weather Concreting (ACI 305), ACI Manual of Concrete Practice, Part 1.
2. "Report on Behavior of Concrete in Hot Climate," by R. Shalon, RILEM No. 62, March–April 1978.
3. "Plastic Shrinkage" by W. Lerch, ACI Journal, February 1957.
4. "Control of Rapid Drying of Fresh Concrete by Evaporation Control," by W. A. Cordon and J. D. Thorpe, ACI Journal, August 1965.
5. "Prevention of Plastic Cracking in Concrete," Concrete Information #ST 80, Portland Cement Association.
6. "Cracking of Fresh Concrete as Related to Reinforcement," by P. D. Cady, et al, ACI Journal, August 1975.

Follow These Rules to Minimize Plastic Shrinkage Cracking

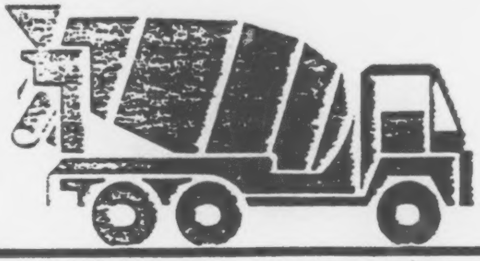
1. Dampen the subgrade and forms.
2. Prevent excessive surface moisture evaporation by providing fog sprays and erecting windbreaks.
3. Cover concrete with wet burlap or polyethylene sheets between finishing operations.
4. Use cooler concrete in hot weather and avoid overheating the concrete in cold weather.
5. Cure properly as soon as finishing has been completed.

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1979

10M/3-87R



BRIEF IN

What, Why & How?
Joints in Concrete Slabs

1. WHAT Are Joints?

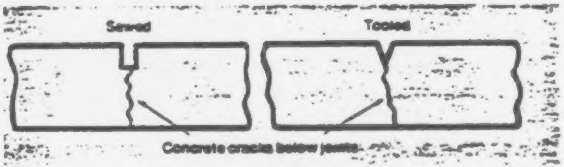
Although concrete expands and contracts with changes in moisture and temperature the general overall tendency is to shrink and, therefore, crack. Irregular cracks are unsightly and difficult to maintain. Joints are simply preplanned cracks.

Some forms of joints are:

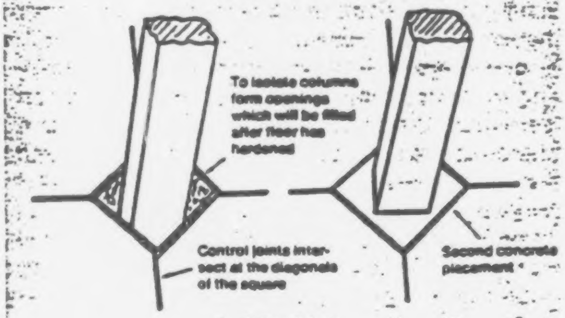
a. Control (contraction) joint—These joints are constructed to create planes of weakness so that cracks will occur at the desired location.

b. Isolation (expansion) joints—They separate or isolate slabs from other parts of the structure such as walls, footings, or columns, and driveways and patios from sidewalks, garage slabs, stairs, lightpoles and other obstructions. They permit movement of the slab and help minimize cracking caused when such movements are restrained.

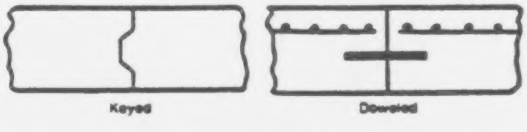
c. Construction joints—These are joints that are placed at the end of a day's work. In slabs they may be designed to permit movement and/or to transfer load. Often in reinforced concrete a conscious effort is made to clean the joint and bond the next day's work.


Sawed
Tooled
Concrete cracks below joints

Control Joints


To isolate columns form openings which will be filled after floor has hardened
Control joints intersect at the diagonals of the square
Second concrete placement

Isolation Joints


Keyed
Doweled

Construction Joints

2. WHY Are Joints Constructed?

Concrete cracks cannot be prevented entirely, but they can be controlled and minimized by properly designed joints, because:

a. Concrete is weak in tension and, therefore, if its natural tendency to shrink is restrained, tensile stresses develop and cracks are likely to occur.

b. At early ages, before the concrete dries out, most cracking is caused by temperature changes or by the slight contraction that takes place as the concrete sets and hardens. Later as the concrete dries it will shrink further and either additional cracks may form or preexisting cracks may become wider.

c. Joints provide relief for the tensile stresses and are less objectionable than random cracks.

3. HOW to Construct Joints

Joints must be carefully designed and properly constructed if uncontrolled cracking of concrete flatwork is to be avoided. The following recommended practices should be observed:

a. The maximum joint spacing in feet should not exceed 2.5 times the thickness in inches. For example in an 8 in. slab the joints should be no further apart than 20 feet.

b. All panels should be square or nearly so. The length should not exceed 1.5 times the width. L-shaped panels should be avoided.

c. The joint groove should have a depth of ¼ the thickness of the slab, but not less than one inch. Tooled joints must be run early in the finishing process and rerun later to assure groove bond has not occurred.

d. Control joints can be tooled during finishing or sawed with a carborundum blade at an early age. Sawed joints may not be practical if the concrete is made with hard aggregate such as quartz gravel or trap rock. Sawing is easier if coarse aggregates contain materials such as limestone or sandstone. If the joint edges ravel during sawing it must be delayed, but if sawing is delayed too long sawing can become difficult. With abrasive saw blades sawing is often done at an age of one day or even earlier.

e. Premolded joint filler, building paper or polyethylene should be used to isolate slabs from building walls or footings. At least two inches of sand over the top of a footing will also prevent bond to the footing.

f. To isolate columns from slabs, form circular or square openings which will not be filled until after the floor has hardened. Slab control joints should intersect at the openings for columns. If square openings are used around columns the square should be turned at 45 degrees to have the control joints intersect at the diagonals of the square.

g. If the slab contains wire mesh cut out alternate wires across control joints. Note that wire mesh will not prevent cracking. Mesh tends to keep the cracks and joints tightly closed.

h. Construction joints key the two edges of the slab together either to provide transfer of loads or to help prevent curling or warping of the two adjacent edges. Galvanized metal keys are preferred for interior slabs, however, a beveled 1 by 2 inch strip, nailed to bulkheads or form boards, can be used in slabs that are at least 5 inches thick to form a key which will resist vertical loads and movements. Metal dowels can also be used in slabs that will carry heavy loads. Dowels must be carefully lined up and parallel or they may induce restraint and cause random cracking at the end of the dowel.

i. Joints in industrial floors subject to heavy traffic require special attention to avoid spalling of joint edges. Such joints should be filled with a material capable of supporting joint edges. Manufacturer's recommendations and performance records should be checked before use.

References

1. ACI 302, Recommended Practice for Concrete Floor and Slab Construction, ACI Manual of Concrete Practice, Part 1.
2. "Why and How: Joints for Floors on Ground," PCA Report #RP206.01B, Portland Cement Association, Skokie, Illinois.
3. "Cracks in Concrete: Causes, Prevention, Repair," A collection of articles from Concrete Construction Magazine, June 1973.

Follow These Rules for Proper Jointing

1. Plan exact location of all joints before construction.
2. Provide isolation joints between slabs and columns, walls and footings, and at junctions of driveways with walks, curbs or other obstructions.
3. Provide control joints and joint filling materials as outlined in specifications.

NRMCA

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1979

CONCRETE IN PRACTICE

What, Why & How? Cracks in Concrete Basement Walls

1. WHAT Types of Cracks May Occur?

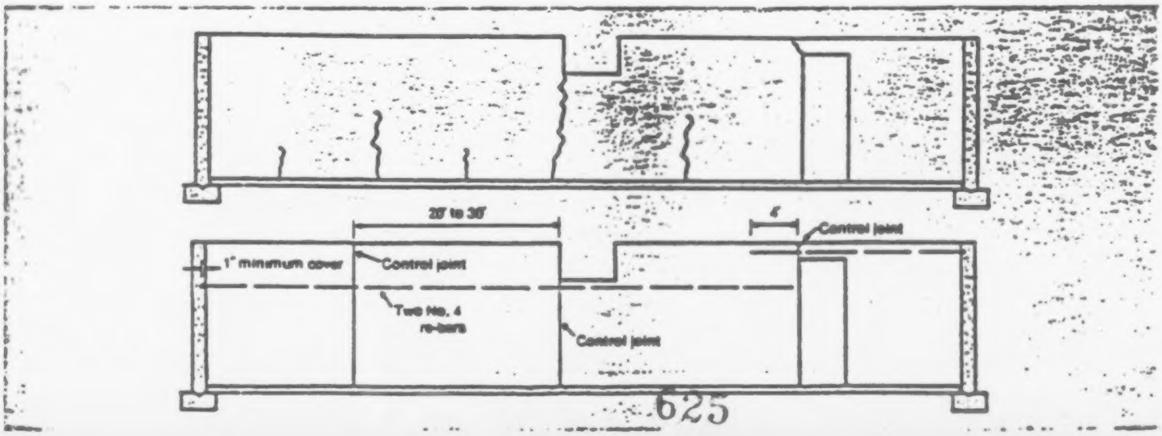
Cast-in-place concrete basements provide durable, high quality extra living space. At times when proper construction practices are not used undesirable cracks occur, such as:

a. Temperature and drying shrinkage cracks. With few exceptions, newly placed concrete has the largest volume that it will ever have. This shrinkage tendency is increased by drying and/or a drop in temperature and can lead to random cracking if steps are not taken to control the location of the cracks by providing control joints.

b. Settlement cracks. These occur from non-uniform support of footings or occasionally from expansive soils.

c. Other structural cracks. In basements these cracks generally occur during backfilling, particularly when heavy equipment gets too close to the walls.

d. Cracks due to lack of joints or improper jointing practices.



2. WHY do Basement Cracks Occur?

In concrete basement walls some cracking is normal. The "Home-Owners Warranty" (HOW Program) requires repair only when cracks leak or exceed the following:

	Crack Width	Vertical Displacement
Basement Walls..........	1/8"	—
Basement Floors..........	3/16"	1/8"
Garage Slabs and Patios...	1/4"	1/4"

Most cracks normally occur because one or more of the following rules of "good concrete practice" were not followed:

a. Providing uniform soil support.

b. Using moderate slump concrete and avoiding addition of water to the concrete mixture on the job.

c. Observing proper concrete placement practices.

d. Providing control joints every 20 to 30 feet.

e. Backfilling carefully and, if possible, waiting until the first floor is in place in cold weather. (Concrete gains strength at a slower rate in cold weather.)

3. HOW to Construct Quality Basements

Since the performance of concrete basements is affected by climate conditions, unusual loads, materials quality and workmanship, care should always be exercised in their design and construction. The following steps should be followed:

a. Site conditions and excavation. Soil investigation should be thorough enough to insure design and construction of foundations suited to the building site. The excavation should be to the level of the bottom of the footing. The soil or granular fill beneath the entire area of the basement should be well compacted by rolling, vibrating or tamping. Footings must bear on undisturbed soil.

b. Formwork and reinforcement. All formwork must be constructed and braced so that it can withstand the pressure of the concrete. Reinforcement is effective in controlling shrinkage cracks and is especially beneficial where uneven side pressures against the walls may be expected. Observe state and local guidelines for wall thickness and reinforcement if needed.

c. Joints. Shrinkage and temperature cracking of basement walls can be controlled by means of properly located and formed joints. As a rule of thumb, in 8 ft. high and 8 inch thick walls, vertical control joints should be provided at a spacing of about 30 times the wall thickness. These wall joints can be formed by nailing a ¾ inch thick strip of wood, beveled from ¾ to ½ inch in width, to the inside of both interior and exterior wall forms. After the removal, the grooves should be caulked with a good quality joint filler.

d. Concrete. In general, use concrete with a moderate slump (up to 5 inches). Avoid retempering. Concrete with a higher slump may be used providing the mixture is specifically designed to produce the required strength without excessive bleeding and/or segregation. In areas where weathering is severe and where the walls may be exposed to moisture and freezing temperatures air entrained concrete should be used.

e. Placement and curing. Place concrete in a continuous operation to avoid cold joints. If concrete tends to bleed and segregate slump must be reduced and the concrete placed in the form every 20 or 30 feet around the perimeter of the wall. Higher slump concretes that do not bleed or segregate will flow horizontally for long distances and reduce the number of required points of access to the form. Provide adequate curing and protection to fresh concrete. It should not be allowed to freeze in cold weather. Preventive measures could be taken by completely enclosing the structure with polyethylene sheets and, if necessary, providing heat.

f. Waterproofing and drainage. Spray or paint the exterior of walls with damp proofing asphaltic compound. Provide foundation drainage by installing drain tiles or plastic pipes around the exterior of the footing, then covering with clean granular fill to a height of at least 1 foot prior to backfill. Water should be drained to lower elevations suitable to receive storm water run off.

g. Backfilling and final grading. Backfilling should be done carefully to avoid damaging the walls. Brace the walls or, if possible, have first floor in place before backfill. To drain the surface water away from the basement finish grade should fall off ½ to 1 inch per foot for at least 8 feet to 10 feet away from the foundation.

References

1. "Control of Cracking in Concrete Structures," report by ACI Committee 224, Journal of the American Concrete Institute, December 1972.
2. "Manual of Acceptable Practices," Volume 4, U.S. Department of Housing and Urban Development.
3. "Solid Concrete Basement Walls," National Ready Mixed Concrete Association.

Technical information prepared by:
NRMCA
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1979

10M/5-85R

CONCRETE IN

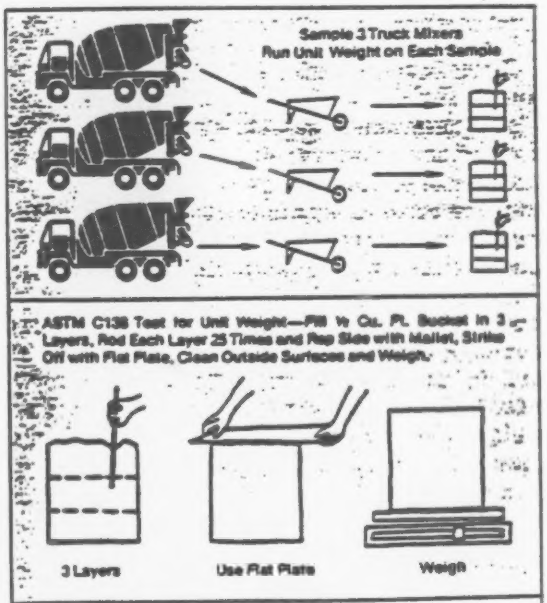
What, Why & How? "Discrepancies in Yield!"

1. WHAT is Concrete Yield?

Concrete yield is defined as the volume of freshly mixed concrete from a known quantity of ingredients. Ready mixed concrete is sold on the basis of the volume of fresh, unhardened concrete—usually in cubic yards (yd^3).

The basis for calculating the volume is described in the American Society for Testing and Materials, ASTM Specification C 94 for Ready Mixed Concrete. The volume of freshly mixed and unhardened concrete in a given batch is determined by dividing the total weight of the batch by the average weight per cubic foot of the concrete determined in accordance with ASTM C 138. Three unit weight tests must be made, each from a different truck using a ½ ft.^{3} container.

ASTM C94 notes: "It should be understood that the volume of hardened concrete may be, or appears to be, less than expected due to waste and spillage, overexcavation, spreading forms, some loss of entrained air, or settlement of wet mixtures, none of which is the responsibility of the producer."


Sample 3 Truck Mixers
Run Unit Weight on Each Sample
ASTM C138 Test for Unit Weight—Fill ½ Cu. Ft. Bucket in 3 Layers, Rod Each Layer 25 Times and Rap Side with Mallet, Strike Off with Flat Plate, Clean Outside Surfaces and Weigh.
3 Layers
Use Flat Plate
Weigh

Unit Weight = Net Concrete Wt. ÷ Bucket Vol. = lb per Cu. Ft.
Avg. Unit Wt = (UW1 + UW2 + UW3) ÷ 3 = lb per Cu. Ft.
Batch Yield (Cu. Ft.) = Weight of Batch ÷ Avg. Unit Wt.
Batch Yield (Cu. Yd.) = Yield (Cu. Ft.) ÷ 27

2. WHY do Yield Problems Occur?

Most yield complaints concern an imagined or real deficiency of concrete volume. Apparent under yield develops when insufficient concrete is ordered to fill the forms and to take care of contingencies discussed below. An actual under yield should be corrected using unit weight measurements and yield calculations. An over yield can, also, be an indication of a problem if the excess concrete is caused by too much air or aggregate, or if the forms have not been properly filled.

Apparent concrete shortages are sometimes caused by the following:

a. Miscalculation of form volume or slab thickness exceeding the assumed thickness by a fraction of an inch. A ⅛ inch error in a 4-inch slab would mean a shortage of 3 percent or 1 yd^3 in a 32 yd^3 order.

b. Deflection or distortion of the forms by the pressure of the concrete.

c. Irregular subgrade, placement over granular fill, and settlement of subgrade prior to placement can increase slab thickness.

d. Over the course of a large job, the small amounts of concrete returned each day or used in mud sills or incidental footings can accumulate.

3. HOW to Prevent Yield Discrepancies

To prevent or minimize concrete yield problems:

a. Check concrete yield by making ASTM C 138 concrete unit weight tests early in the job. Repeat these tests if a problem arises. Be sure that the scale is accurate, that the unit weight bucket is properly calibrated and that a flat plate is used for strike off. Concrete yield volume in cubic feet is total batch weight in pounds divided by unit weight in pounds per cubic foot. The total batch weight is the sum of the weights of all ingredients from the batch ticket. As a rough check the mixer truck can be weighed empty and full. The difference is the total batch weight.

b. Measure formwork accurately. Near the end of large pours, carefully measure the remaining volume so that the amount in the last 2 or 3 trucks can be adjusted to provide the required concrete. This can prevent waiting for an extra ½ yd^3 after the plant has closed or the concrete trucks have been scheduled for other jobs.

c. Estimate extra concrete needed for waste and increased placement dimensions over nominal dimensions. Include an allowance of 4 to 10 percent over plan dimensions for waste, overexcavation and other causes. Repetitive operations and slip form operations permit more accurate estimates of the amount of concrete that will be needed. On the other hand, sporadic operations involving a combination of concrete uses such as slabs, footings, walls, and as incidental fill around pipes, etc. will require a bigger allowance for contingencies.

d. Construct forms so that they can withstand the pressure of the concrete without deflection or distortion.

e. For slabs on grade the subgrade should be accurately finished and compacted to the proper elevation.

References

1. ASTM C 94, Standard Specification for Ready Mixed Concrete, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
2. ASTM C 138, Standard Test Method for Unit Weight, Yield and Air Content of Concrete, American Society for Testing and Materials.
3. "An Analysis of Factors Influencing Concrete Pavement Cost," by Harold J. Halm, Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.

Follow These Rules to Avoid Under Yield

1. Measure volume needed accurately.
2. Estimate waste and potential increased thickness—order more than required by at least 4 to 10 percent.
3. To check yield use the ASTM C 138 unit weight test method on three samples from three different loads—yield is the total batch weight divided by the average unit weight.

NRMCA
Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A. © NATIONAL READY MIXED CONCRETE ASSOCIATION, 1979 10M/3-87R

CONCRETE IN PRACTICE

CIP 9

What, Why & How? Low Concrete Cylinder Strength

1. WHAT Constitutes Low Cylinder Strength?

Cylinders are molded from a sample of fresh concrete. Procedures must be in accordance with ASTM standards.[1] The average strength of the set of 2 or 3 cylinders, broken at 28 days, constitutes one "test." Additional cylinders are often made for 7 day tests or to be field cured for form stripping.

Under ACI Standards,[2] concrete is acceptable if no one "test" is lower than specified by more than 500 psi and the average of three consecutive "tests" equals at least the specified strength. If an average of three "tests" in a row dips below the specified strength, steps must be taken to increase the strength of the concrete. If a "test" falls more than 500 psi below the specified strength there may be more serious problems. An investigation would be made to ensure structural adequacy; and, again, steps taken to increase the strength level.

2. WHY Are Compressive Tests Low?

Two major reasons are: (a) improper handling and testing—found to contribute in the majority of low strength investigations, and (b) reduced concrete quality due to an error in production, or the addition of too much water to the concrete on the job due to delays in placement or requests for wet concrete. High air content, for example, can be a cause of low strength.

4000 psi Specified Strength

Test No.	Individual Cyl. No. 1	Individual Cyl. No. 2	Test Average	Average of 3 Consecutive
		Acceptable Example		
1	4110	4260	4185	—
2	3840	4080	3960	—
3	4420	4450	4435	4193
4	3670	3820	3745	4047
5	4620	4570	4595	4258
		Low Strength Example		
1	3620	3550	3585	—
2	3970	4060	4015	—
3	4080	4000	4040	3880
4	4860	4700	4780	4278
5	3390	3110	3250†	4023

*Average of 3 consecutive low.
†One "test" more than 500 psi low.

Collect all test reports and analyze results before taking action. Look at the pattern of strength results. Does the sequence actually violate the specification? Do the test reports give any clue to the cause? Look at the slump, air content, concrete and ambient temperatures, number of days cylinders were left in the field, and any reported cylinder defects.

If the deficiency justifies investigation, first verify testing accuracy and then compare the structural requirements with the measured strength.[3] If testing is deficient or if strength is greater than that actually needed, there is little point in investigating the in-place strength. However, if procedures conform to the standards and the specified strength is required for the member in question, further investigation of the in-place concrete may be required. (See CIP-10 on "Strength of In-Place Concrete.")

Have ASTM testing procedures been followed? Minor discrepancies in curing cylinders in mild weather will probably not affect strength much, but if major violations are discovered large reductions in strength can occur.[4] Almost all deficiencies in handling and testing cylinders will lower strength. A number of violations may combine to cause significant reductions, such as: extra days in the field; curing over 80F; frozen cylinders; impact during transportation; delay in curing at the lab; improper caps; and insufficient care in breaking cylinders.

The laboratory should be held responsible for deficiencies in its procedures. Use of qualified lab personnel is essential; untrained construction workers must not make and handle cylinders. All labs should be NVLAP accredited and CCRL inspected.[5,6]

5. HOW to Make Standard Cylinder Tests

It is essential that testing personnel be trained in the proper application of the ASTM Standards for strength tests of field-made, laboratory-cured cylinders:

a. Sample concrete falling from chute in two increments after some has been discharged.
b. Transport sample to the location of curing for the first day.
c. Remix the sample to ensure homogeneity.
d. Use molds conforming to standards.
e. Rod concrete in three layers and tap sides of the mold to close rod holes.
f. Finish tops smooth and level to allow thin caps.
g. If necessary, move cylinders immediately after molding; support the bottom.
h. Cure cylinders in the field at 60 to 80F.
i. Protect from loss of moisture.
j. Transport day-old cylinders to the laboratory; handle gently.
k. Demold and promptly place in moist curing at 73±3F.
l. Maintain water on cylinder surfaces at all times.
m. Caps on cylinders must be flat and less than 3/16 inch thick.
n. Use minimum 5000 psi capping material.
o. Wait at least 2 hours for sulfur caps to harden.
p. Use calibrated testing machine.
q. Measure cylinder diameter and check cap planeness.
r. Center cylinder and use proper loading rate.
s. Observe break pattern (vertical cracks through the cap indicate improper load distribution).

Test reports must be promptly distributed to the concrete producer, as well as the contractor and engineer. This is essential to the timely solution of problems.

References

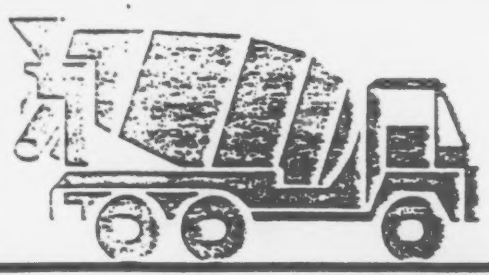
1. ASTM Standards C 31, C 39, C 172, C 470, and C 617. American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103. Changes are expected in C 31 in 1983.
2. "Building Code Requirements for Reinforced Concrete." ACI 318-77 Part 3, Chap. 4. American Concrete Institute, P. O. Box 19150, Detroit, Mich. 48219.
3. "In-Place Concrete Strength Evaluation—A Recommended Practice." NRMCA Publication No. 133.
4. "Effect of Curing Condition on Compressive Strength of Concrete Test Specimens." NRMCA Publication No. 53.
5. National Voluntary Laboratory Accreditation Program (NVLAP), National Bureau of Standards, Tech. Bldg., B06, Washington, D.C. 20234 (301-921-2368).
6. Cement and Concrete Research Laboratory (CCRL), National Bureau of Standards, Washington, D. C. 20234.

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1982

10M/3-84
10M/12-87R



CONCRETE IN PRACTICE

CIP 10

What, Why & How? Strength of In-Place Concrete

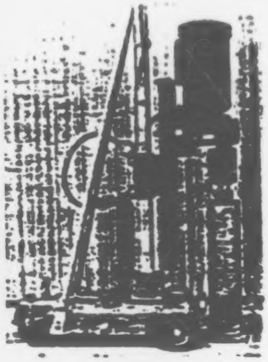
1. WHAT is the Strength of In-Place Concrete?

Drilled cores test lower than *properly made and tested* standard molded 6 in. × 12 in. cylinders.[1] This applies to all formed structural concrete. Exceptions may occur for cores from concrete cast against an absorptive subgrade or cores from lean, low strength mass concrete.

Means of measuring or comparing the strength of in-place concrete include: rebound hammer, penetration probe, pullouts, cast-in-place cylinders, tests of drilled cores, and load tests of the structural element.

The standard ASTM test procedure evaluates the strength potential of the concrete.[2] Cylinders are molded and cured at 60 to 80F for one day and then moist cured in the laboratory until broken in compression, normally at 7 and 28 days age. Job practices for handling, placing, compaction, and curing of job concrete are relied upon to provide an adequate percentage of that potential strength in the structure. The ACI Building Code recognizes that under current design practices, concrete construction can be considered structurally adequate if cores average at least 85 percent of specified strength with none below 75 percent.

Rebound Test (ASTM C805)



Core Test (ASTM C42)

2. WHY Measure In-Place Strength?

Tests of in-place concrete may be needed when standard cylinder strengths are low; however, do not investigate in-place without first checking to be sure that: the concrete strengths actually failed to meet the specification provisions; low strengths are not attributable to faulty testing practices; and the specified strength is really needed. (See CIP-9 on "Low Concrete Cylinder Strength.") In many cases, the concrete can be accepted for the intended use without in-place strength testing.

There are many other situations which may require the investigation of in-place strength, including: shore and form removal, post-tensioning, or early load application; investigation of damage due to freezing, fire, or adverse curing exposure; evaluation of older structures; and when a lower strength concrete is placed in a member by mistake. When cores or other in-place tests fail to assure 85 percent of the design strength, additional curing of the structure may provide the necessary strength. This is particularly possible with concretes containing slow strength-gaining cement, fly ash, or slag.

3. HOW to Investigate In-Place Strength

If only one set of cylinders is low, often the question can be settled by comparing rebound hammer or probe results on concrete from areas with good cylinder results. Where the possibility of low strength is such that large portions need to be investigated a well organized study will be needed. Establish a grid and obtain systematic readings including good and questionable areas. Tabulate the hammer or probe readings. If areas appear to be low, drill cores from both low and high areas. If the cores confirm the hammer or probe results, the need for extensive core tests is greatly reduced.

Core Strength, ASTM Method C 42—If core drilling is necessary observe these precautions: (a) test 3 cores, (b) use 3½ in. minimum diameter and larger cores for over 1 in. aggregate, (c) try to obtain a length at least 1½ times the diameter, (d) trim to remove steel if the 1½ L/D ratio can be maintained, (e) trim ends square with an automatic feed diamond saw, (f) keep cap thickness under ⅛ in., (g) use high strength capping material, (h) check planeness of caps and bearing blocks, (i) do not drill cores from the top layers of columns, slabs, walls, or footings. They will be 10 to 20 percent weaker than cores from the mid or lower portions, and (j) test cores after drying for 7 days if the structure is dry in service; otherwise soak cores 40 hours prior to testing.

Probe Penetration Resistance, ASTM Method C 803—Probes driven into concrete can be used to study variations in concrete quality: (a) different size probes or a change in driving force may be necessary for large differences in strength or unit weight, (b) accurate measurement of the exposed length of the probe is required, (c) probes should be spaced at least 7 in. apart and not be close to the edge of the concrete, (d) probes not firmly embedded in the concrete should be rejected and, (e) develop a strength calibration curve for the materials and conditions under investigation.

Rebound Hammer, ASTM Method C 805—Observe these precautions: (a) wet all surfaces for several hours or overnight because drying affects rebound number, (b) don't compare readings on concrete cast against different form materials or concrete of varying moisture content or readings from different impact directions or on members of different mass, or results using different hammers, (c) don't grind unless the surface is soft, finished or textured, (d) test structural slabs from the bottom, and (e) don't test frozen concrete.

Advance Planning—When it is known in advance that in-place testing is required, such as for shore and form removal, other methods can be considered such as: cast-in-place, push-out cylinders and pullout strength measuring techniques covered by ASTM Methods C 873 and C 900.

References

1. ACI Bibliography 13 on Core Tests. American Concrete Institute, P. O. Box 19150, Detroit, Mich. 48219.
2. ASTM C 31, "Making and Curing Test Specimens in the Field" and C 39, "Compressive Strength of Cylindrical Concrete Specimens," American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103. Changes in C 31 are expected in 1983.
3. ASTM C 805, "Rebound Number of Hardened Concrete."
4. ASTM C 803, "Penetration Resistance of Hardened Concrete."
5. ASTM C 900, Pullout Strength of Hardened Concrete."
6. ASTM C 873, "Strength of Cast-in-Place Cylinders."
7. ASTM C 42, "Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
8. "Building Code Requirements for Reinforced Concrete." ACI 318-77, Part 3, Chap. 4.
9. "In-Place Strength Evaluation—A Recommended Practice," NRMCA Publication No. 133.

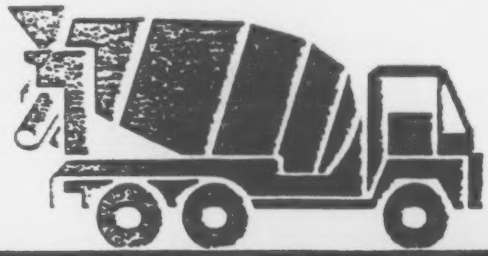
NRMCA

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1982

10M/3-84
10M/4-86R



CONCRETE IN PRACTICE

CIP 11

What, Why & How? Curing In-Place Concrete

1 WHAT is Curing?

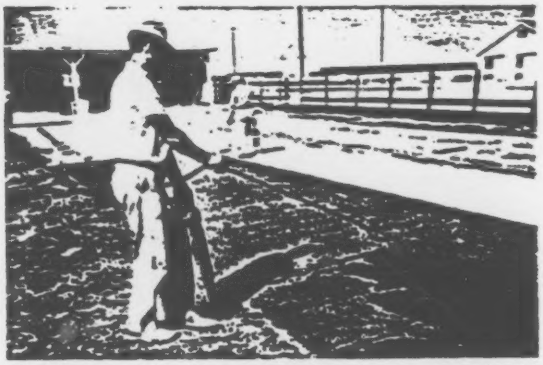
Curing is the maintaining of a satisfactory moisture content and temperature in concrete. Curing begins after placement and finishing so that the concrete may develop the desired strength and hardness.

Without an adequate supply of moisture, the portland cement in the concrete cannot react to form a quality product. Drying may remove the water needed for this chemical reaction called "hydration" and the concrete will be weak. Temperature is an important factor in proper curing, since the rate of hydration is temperature dependent. For exposed concrete, relative humidity and wind conditions are also important; they contribute to the rate of moisture loss from the concrete.

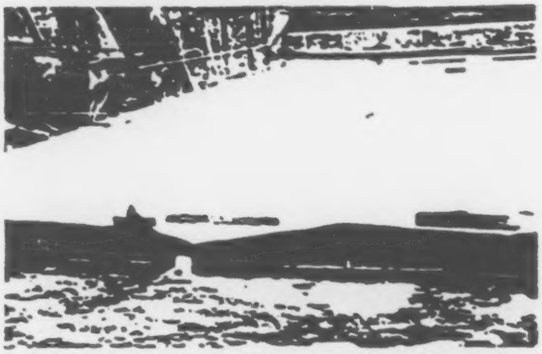
2 WHY Cure?

Several important reasons are:

a. Predictable strength gain. Laboratory tests show that concrete in a dry environment can lose as much as 50 percent of its potential strength compared to similar concrete that is moist cured.' Concrete placed under high temperature conditions will gain early strength quickly but later strengths may be reduced.



Application of liquid membrane-forming compound with hand sprayer.



Slab-on-grade covered with waterproof paper for curing.

Concrete placed in cold weather will take longer to gain strength, delaying form removal and subsequent construction.

b. Improved durability, especially of non-air-entrained concrete slabs that may be subject to freezing conditions during construction. Well cured concrete has better surface hardness and therefore is more watertight.

c. Better serviceability and appearance. A concrete slab that has been allowed to dry out too early will have a soft surface with poor resistance to wear and abrasion. Proper curing reduces crazing, dusting, and scaling.[2]

3. HOW to Cure

Moisture Requirements for Curing—the concrete surface must be kept continuously wet or sealed to prevent evaporation for a period of at least several days after finishing. See the table for examples.

Systems to keep concrete wet include:

a. Burlap or cotton mats and rugs used with a soaker hose or sprinkler. Care must be taken not to let the coverings dry out and adsorb water from the concrete. The edges should be lapped and the materials weighted down so that they are not blown away.

b. Straw that is sprinkled with water regularly. Straw can easily blow away, and if it drys, can catch fire. The layer of straw should be 6 inches thick, and should be covered with a tarp.

c. Sprinkling on a continuous basis is suitable provided the air temperature is well above freezing. The concrete should not be allowed to dry out between soakings, since alternate wetting and drying may damage the concrete.

d. Ponding of water on a slab is an excellent method of curing. The water should not be more than 20° F cooler than the concrete and the dike around the pond must be secure against leaks.

e. Damp earth, sand, or sawdust will cure flatwork, especially floors. There should be no organic or iron staining contaminants in the materials used.

Sealing materials include:

a. Liquid membrane-forming compounds—must conform to ASTM Specifications[3] at the rate of application that is specified. Apply to the concrete surface about one hour after finishing. Do not apply to concrete that is still bleeding, or has a visible water sheen on the surface. While a clear liquid may be used, a white pigment will give reflective properties, and allow for inspection of coverage. A single coat may be adequate, but where possible a second coat, applied at right angles to the first, is desirable for even coverage. If the concrete will be painted, or covered with vinyl or ceramic tile, then a liquid compound that is non-reactive with the paint or adhesives must be used, or a compound that is easily brushed or washed off. On floors, the surface should be protected from the other trades with scuff-proof paper after the application of the curing compound.[4]

Example Minimum Curing Period to Achieve 50% of Specified Strength*

Type I Cement	Type II Cement	Type III Cement
Temperature—50°F		
[illegible] days	[illegible] days	3 days
Temperature—70°F		
[illegible] days	6 days	3 days

*[illegible] approximate; specific values should [illegible] for your mixtures and materials.

b. Plastic sheets—either clear, white (reflective) or pigmented. Plastic should conform to ASTM Standards[5], be at least 4 mils thick, and preferably reinforced with glass fibers. The plastic should be laid in direct contact with the concrete surface as soon as possible without marring the surface. The edges of the sheets should overlap and be fastened with waterproof tape and then weighted down to prevent the wind from getting under the plastic. Plastic will make dark streaks wherever a wrinkle touches the concrete so plastic should not be used on concretes where appearance is important.

c. Waterproof paper—used like plastic sheeting, but does not mar the surface. Should also confrom to ASTM Standards.[5]

References

1. "Effect of Curing Condition on Compressive Strength of Concrete Test Specimens," NRMCA Publication No. 53.
2. "How to Eliminate Scaling," Concrete International, February, 1980. American Concrete Institute, Box 19150 Redford Station, Detroit, Michigan 48219.
3. ASTM C 309, "Specification for Liquid Membrane Forming Compounds for Curing Concrete," American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa. 19103.
4. ACI 308, "Standard Practice for Curing Concrete," ACI Manual of Concrete Practice, Part 2, American Concrete Institute.
5. ASTM C 171, "Specification for Sheet Materials for Curing Concrete," American Society for Testing Materials.
6. ACI 306, "Cold Weather Concreting," ACI Manual of Concrete, Part 2, American Concrete Institute.

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1982

30M/12-82
10M/4-86R

CONCRETE IN PRACTICE

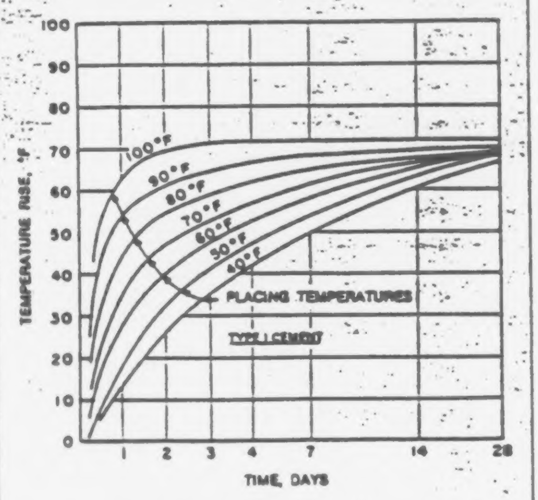
What, Why & How? Hot Weather Concreting

1. WHAT is Hot Weather?

Hot weather may be defined as any period of high temperature in which special precautions need to be taken to ensure proper handling, placing, finishing and curing of concrete. Hot weather problems are most frequently encountered in the summer, but the associated climatic factors of high winds and dry air can occur at any time, especially in arid or tropical climates. Hot weather conditions can produce a rapid rate of evaporation of moisture from the surface of the concrete, and accelerated setting time, among other problems.[1] Generally high relative humidity tends to reduce the effects of high temperature.

2. WHY Consider Hot Weather?

It is important that hot weather be taken into account when planning concrete projects because of the potential effects on fresh and recently placed concrete. High temperatures alone cause increased water demand, which in turn will raise the water-cement ratio and yield lower potential strength. Higher temperatures tend to accelerate slump loss and can cause loss of entrained air. Temperature also has a major effect on the setting time of concrete; concrete placed under high temperatures will set quicker and can therefore require more rapid finishing. Concrete that is cured at high



Temperature Rise of Mass Concrete

ACI 207.2R-73, Figure 3.3

temperatures early will not be as strong at 28 days as the same concrete cured at more moderate (70F) temperatures.

High temperatures, high wind velocity, and low relative humidity can affect fresh concrete in two important ways; the high rate of evaporation may induce early plastic shrinkage or drying shrinkage cracking, and the evaporation rate can remove surface water necessary for hydration unless proper curing methods are employed. Thermal cracking may result from rapid drops in the temperature of the concrete, such as when concrete slabs or walls are placed on a hot day followed by a cool night. High temperature also accelerates cement hydration and contributes to the potential for cracking in massive concrete structures.

3. HOW to Concrete in Hot Weather

The key to successful hot weather concreting is (1) recognition of the factors that affect concrete and (2) planning to minimize their effects. Use proven, local recommendations for adjusting concrete proportions, such as use of water reducing, set retarding admixtures. Perhaps a moderate heat of hydration cement (ASTM Type II—moderate heat)[2] or pozzolanic admixture (fly ash) can reduce the effects of high temperatures.

Advance timing and scheduling to avoid delays in delivery, placing and finishing is a must; trucks should be able to discharge immediately and adequate personnel should be available to place and handle the concrete. When possible, deliveries should be scheduled to avoid the hottest part of the day.

In the case of extreme temperature conditions or with mass concrete, the concrete temperature can be lowered by using chilled water or ice as part of the mixing water.[3]

Other measures such as sprinkling and shading the aggregate prior to mixing, can be used to help lower the temperature of the concrete. If low humidity and high winds are predicted, then windbreaks, sunscreens or mist fogging may be needed to avoid plastic shrinkage cracking in slabs.

Follow These Rules for Hot Weather Concrete

a. Concrete mixture designs may include: set retarders and water reducers,[4] the lowest practical cement factor. Modify mixtures as appropriate—retarders, moderate heat of hydration cement,[2] pozzolanic admixtures or other proven local solutions.[5]
b. Adequate manpower to quickly place, finish and cure the concrete.
c. Limit the addition of water at the job site—add water only on arrival at the job site to adjust the slump. Later additions should be avoided; in no instance should they exceed 2 or 2½ gallons per cubic yard. Never add water to concrete that is more than 1½ hours old.
d. Slabs on grade should not be placed on polyethylene sheeting—if a vapor barrier is required, then a bed of damp sand should be placed over it.
e. Finish as soon as the sheen has left the surface; start curing as soon as finishing is completed. Continue curing for at least 3 days: cover to prevent evaporation or use a liquid membrane curing compound, or cure slabs with water. (See CIP 11) The addition of white pigment to membrane curing compounds will help by reflecting heat away from the concrete surface.
f. Moisten the subgrade, forms and reinforcement prior to placement. However, avoid standing water.
g. Protect field test cylinders by shading and preventing evaporation. Field curing boxes with ice or refrigeration may be used to ensure required 60–80F for cylinders.[6] (See CIP 9)
h. Do not use accelerators!

References

1. ACI 305, "Hot Weather Concreting," ACI Manual of Concrete Practice, Part 2. American Concrete Institute, P. O. Box 19150, Detroit, Michigan 48219.
2. ASTM C 150, "Standard Specification for Portland Cement," American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
3. "Cooling Ready Mixed Concrete," NRMCA Publication No. 106.
4. ASTM C 494, "Chemical Admixtures for Concrete."
5. ASTM C 618, "Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
6. ASTM C 31, "Making and Curing Concrete Test Specimens in the Field."

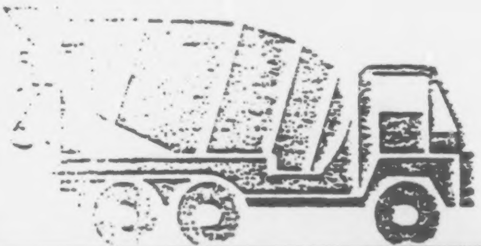
NRMCA

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

© NATIONAL READY MIXED CONCRETE ASSOCIATION 1983

15M/3-84



CONCRETE IN PRACTICE

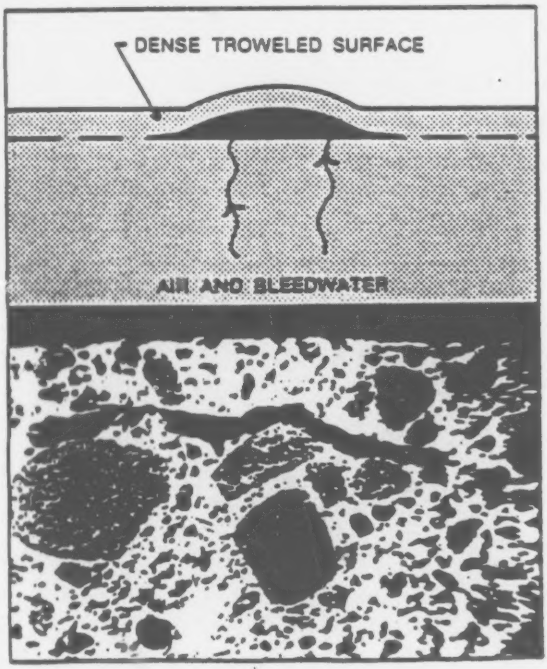
What, Why & How? Concrete Blisters

WHAT are Blisters?

Blisters are hollow, low-profile bumps on the concrete surface typically from the size of a dime up to an inch, but occasionally even 2 or 3 inches in diameter. A dense troweled skin of mortar about ⅛ in. thick covers an underlying void which moves around under the surface during troweling.

The void forms under a dense surface skin by one of two phenomenon. Some believe that incidental air voids rise in sticky concretes and are trapped under a dense surface skin produced by troweling. Others believe that bleed water rises and collects to form a void under this skin. That water is reabsorbed into the underlying concrete leaving a layer of irregular void space under the surface which is then consolidated by troweling to form a round blister which moves during subsequent troweling. Frequently, the blister is lined with a faint layer of "washed" sand.

In poorly lighted areas, small blisters may be difficult to see during finishing and may not be detected until they break under traffic.



Concrete Blister

WHY Do Blisters Form?

Blisters form when the fresh concrete surface is sealed by troweling while the underlying concrete is plastic and bleeding or able to release air. The small round blisters form fairly late in the finishing process, after floating and after the first troweling.

Moderately rapid evaporation of bleed water makes the surface ready to be troweled while the underlying concrete is still bleeding or still plastic and releasing air. Evaporation from the surface is increased by wind, low relative humidity or a warm concrete surface. If evaporation is too rapid, the slab will be affected to a depth of an inch or more and blisters will be prevented—but plastic shrinkage cracks may develop!

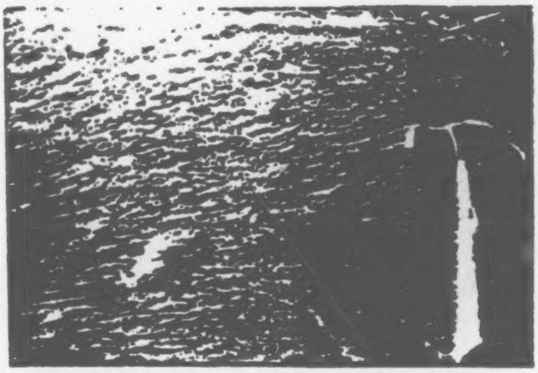
Entrained air is often involved since it reduces the rate of bleeding and supplies the fat necessary to produce the dense impermeable surface layer. A cool subgrade will delay set in the bottom and make the top set first.

Blisters are more likely to form if:

(1) The subgrade is cool and the concrete in the bottom sets slowly.
(2) Entrained air is used or is higher than normal so that the surface is ready to finish earlier.
(3) A dry shake is used, particularly over air-entrained concrete.
(4) The concrete is sticky from higher cement content or excessive fine sand. Lean mixes bleed rapidly for a shorter period, have higher total bleeding and tend to delay finishing.
(5) The slab is thick.
(6) The slab is on polyethylene and the slump is less than 3 or 4 inches.
(7) Excessive use of a jitterbug or a vibrating screed which works up a thick mortar layer on top.

HOW to Prevent Blisters

The finisher should be wary of a concrete surface that appears to be ready to trowel before it would normally be expected to be. Emphasis in finishing should be on placing, straightedging and floating the concrete as rapidly as possible and without working up an excessive layer of fat. After these operations are completed, further finishing should be delayed as long as possible and the surface covered with polyethylene or otherwise protected from evaporation. In initial floating the float blades should be flat to avoid densifing the surface too early. Use of an accelerator or heated concrete often prevents blisters in cool weather.



If blisters are forming, try to either flatten the trowel blades or tear the surface with a wood float and delay finishing as long as possible. Any steps that can be taken to slow evaporation should help.

References

1. "Guide for Concrete Floor and Slab Construction," ACI 302.1R-80, Sections 2.4.1, 8.4 and 11.7. Concrete International, June 1980, pp. 51-96 and ACI Manual of Concrete Practice, Part 2, 1983. American Concrete Institute, P.O. Box 19150 Redford Station, Detroit, MI 48219.
2. Carl O. Peterson, "Concrete Surface Blistering—Causes and Cures," Concrete Construction, September 1970, p. 317. Concrete Construction Publications, Inc., 426 S. Westgate, Addison, IL 60101.
3. "Finishing," Concrete Construction, August 1976, p. 389.
4. J. C. Yeager, "Finishing Problems and Surface Defects in Flatwork," Concrete Construction, April 1979, pp. 247-258.
5. Problems and Practices, ACI Journal, December 1955, p. 492.

Follow These Rules to Avoid Blisters

1. Do not seal surface before air or bleed water from below have escaped.
2. Avoid dry shakes on air-entrained concrete.
3. Use heated or accelerated concrete to promote even setting throughout the depth of the slab.
4. Do not place slabs directly on polyethylene sheeting.

NRMCA
Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U S A

© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1983

15M/3-84

CONCRETE IN PRACTICE

CIP 14

What, Why & How? Finishing Concrete Flatwork

WHAT is Finishing?

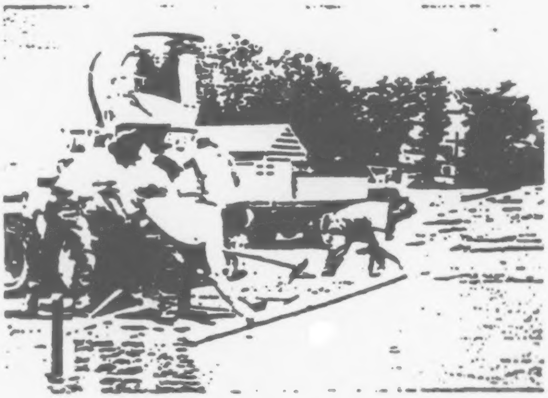
Finishing is the operation of consolidating, leveling, and creating a concrete surface of a desired texture and hardness. The finish can be strictly functional or decorative.

WHY Finish Concrete?

Finishing makes concrete attractive and serviceable. The final texture, hardness, and joint pattern on slabs, floors, sidewalks, patios, and driveways depends on the concrete's end use. Warehouse or industrial floors usually need to be level and smooth, while other interior floors that are covered with carpet do not have to be as exact. Exterior slabs must be sloped to carry away water and must provide a texture which will not be slippery when wet.

HOW to Finish Concrete

The finishing operation should be carefully planned. Skill, knowledge and experience are required to deal with a variety of concrete mixtures and field conditions. Having the proper manpower and equipment available, and timing the operations properly for existing conditions, is critical. A slope of ¼ in. per foot is necessary to avoid low spots and to drain water away from buildings.



Finishing Concrete Flatwork

Delays after the concrete arrives create problems in finishing and can reduce final quality. Complete the excavation, compaction, form work and placement of mesh and rebars ahead of time.

Guidelines for placing and consolidating concrete are:

a. A successful job depends on selecting the correct concrete mix for the job. Consult your Ready Mixed Concrete Producer.

b. If possible place concrete directly from the truck chute or use wheelbarrows, buggies or pumps to avoid excessively wet, high slump concrete. Start at the far end and work to the near end. On a slope use stiffer concrete and work up the slope.

c. Spread the concrete using a short-handled, square-ended shovel, a concrete rake, or a come-along. Do not use a garden rake since it will cause segregation.

d. Tamp the concrete with a spade or 2 by 4 along the edges of the forms to release air voids and consolidate the concrete.

e. Use a lumber or metal straightedge (called a screed) to strike off the concrete and level it. Rest the screed on edge on the top of the forms, tilt it forward and draw it across the concrete with a sawing motion. Keep a little concrete in front of the screed to fill in any low spots.

Follow These Rules to Finish Concrete

a. **FLOAT** the concrete as soon as it has been struck-off. A float is a wood or metal tool used to further level the concrete surface and to embed the large aggregate. On small jobs a float is hand-held; on larger jobs a long-handled bull float may be used. One or two passes should be enough to smooth and level the surface without sealing the concrete. Floating must end before visible bleed water rises to the surface.

b. **WAIT** for the concrete to stop "bleeding". Bleeding occurs as the solids in the concrete settle. All other finishing operations **MUST WAIT** until the concrete has stopped bleeding and the water sheen has left the surface. Any finishing operations done while the concrete is still bleeding **WILL RESULT** in later problems such as dusting, scaling, crazing and blisters. The waiting period depends on: the amounts of water, cement and chemical admixtures in the concrete; and the weather.[1]

c. **EDGE** the concrete all the way around. Spade the concrete next to the form gently with a small mason's trowel and then use the edging tool to give the concrete rounded edges.

d. **JOINT** the concrete by grooving it. The jointer should have a blade one-fourth the depth of the slab (1 in. deep joints on a 4 in. slab). Use a straight piece of lumber as a guide. A shallow-bit groover should only be used for decorative grooves. See CIP 6 for joint spacing.[1]

e. **TROWEL** the concrete according to its end use. For sidewalks, patios and driveways, troweling may not be required. Repeated passes with a steel trowel will produce a smooth floor that will be slippery when wet. For a smooth floor make successive passes with a smaller steel trowel and increased pressure. Excessive troweling may create dark "trowel burns." Tilting the trowel will cause an undesirable "chatter" texture.

f. **TEXTURE** the concrete surface after floating (for sidewalks, patios or driveways) or after troweling (for interior flatwork) with a coarse or fine push-broom to give a non-slip surface. For information about architectural surface finishes such as exposed aggregate, dry shake color, integral color, and stamped or patterned concrete see Reference No. 2.

g. **NEVER** sprinkle water or cement on concrete while finishing it. This may cause dusting or scaling.[1]

h. **CURE** the concrete as soon as all finishing is completed and the water sheen has left the surface. Some methods of curing are: liquid curing compounds; plastic to cover the concrete; ponding; continuous sprinkling; burlap, and straw or sand that is kept wet. Plastic or sand may discolor the concrete surface.[1]

References

1. "Concrete In Practice" (CIP) Series. Available from: National Ready Mixed Concrete Association, 900 Spring Street, Silver Spring, Maryland 20910.
2. "Cement Mason's Guide," Publication No. PA122.02H, Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.
3. "Residential Concrete," National Association of Home Builders, 15th & "M" Sts., N.W., Washington, D.C. 20005.
4. "Concrete Craftsman Series — Slabs on Grade," American Concrete Institute, P.O. Box 19150 Redford Station, Detroit, Michigan 48219.
5. ACI 302. "Guide for Concrete Floor and Slab Construction," ACI Manual of Concrete Practice, Part 2. American Concrete Institute.
6. "Finishing and Related Problems," Concrete Construction Magazine, 426 S. Westgate, Addison, Illinois 60101.

Technical Information prepared by:

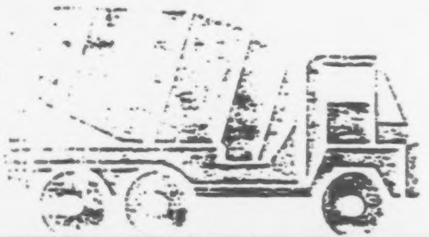
National Ready Mixed Concrete Association

900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

NATIONAL READY MIXED CONCRETE ASSOCIATION 1986

10M/4-87R



CONCRETE IN PRACTICE

CIP 5

What, Why & How? Chemical Admixtures for Concrete

WHAT are Admixtures?

Admixtures are natural or manufactured chemicals which are added to the concrete before or during mixing. The most often used admixtures are air-entraining agents, water-reducers, retarders and accelerators.

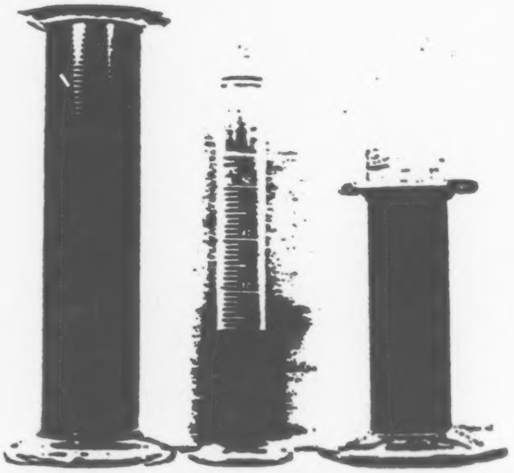
WHY Use Admixtures?

Admixtures are used to give special properties to fresh or hardened concrete. Admixtures may enhance the durability, workability or strength characteristics of a given concrete mixture. Admixtures are used to overcome difficult construction situations such as hot or cold weather placements, pumping requirements, early strength requirements or very low water-cement ratio specifications.

HOW to Use Admixtures

Consult your Ready Mixed Concrete Supplier about which admixture(s) may be appropriate for your application. Admixtures should be evaluated for compatibility with cement(s), construction practices, job specifications and economic advantage before being used.

Chemical Admixtures for Concrete



L to R: HRWR, Air-Entraining Agent, Retarder
Relative quantities for one cu.yd.

E. **FOLLOW THIS GUIDE** to Use Admixtures

a. *AIR-ENTRAINING AGENTS*[1] are liquid chemicals added during mixing to produce microscopic air bubbles in concrete. These bubbles improve the concrete's durability and increase its resistance to damage from freezing and thawing and deicing salts. Air-entraining admixtures improve workability and may reduce bleeding and segregation. For exterior flatwork (parking lots, driveways, sidewalks, pool decks, patios) that is subject to freezing and thawing weather cycles, or in areas where deicer salts are used, specify an air content of 5 to 7%. Air-entrainment is not necessary for interior structural concrete since it is not subject to freezing and thawing. In high cement content concretes adding air will reduce strength by about 5% for each 1% of air added; but in low cement content concretes adding air has less effect and may increase strength slightly.

b. *WATER-REDUCERS* are used for two different purposes: (1) to lower the water content and increase the strength; (2) to obtain higher slump using the same water content. Water-reducers will generally reduce the required water content for a given slump by about 10%. This increases strength or allows the cement content to be reduced and maintain the same water-cement ratio. Water-reducers are used to increase slump for pumping concrete and are used in hot weather to offset the increased water demand. Water-reducers may aggravate slump loss problems. Water reducers tend to retard concrete and sometimes have accelerators blended in to offset the retardation. Water-reducers are Type A Chemical Admixtures in ASTM C 494.[2]

c. *RETARDERS* are chemicals which delay the initial set of concrete by an hour or more. Retarders are often used in hot weather to counter the rapid setting caused by high temperatures. For large jobs, or in hot weather, specify concrete with retarder to allow more time for placing and finishing. Most retarders also act as water reducers. Retarders are covered by ASTM C 494[2] Types B and D.

d. *ACCELERATORS* reduce the initial set time of concrete. Liquid accelerators are added to the concrete at the plant. Accelerators are recommended in cold weather to get high-early strength. Accelerators do not act as an antifreeze; rather, they speed up the strength gain and make the concrete stronger to resist damage from freezing. Accelerators are sometimes used to allow finishing operations to begin early. Calcium chloride is the most commonly used accelerator, although non-chloride (non-corrosive) accelerators are available. Calcium chloride is specified at not more than 2% by the weight of the cement. Prestressed concrete and concrete with embedded aluminum or galvanized metal should not contain any calcium chloride because of the potential for corrosion. See NRMCA Publication No. 173.[3] Accelerators are covered by ASTM C 494[2] Types C and E.

e. *HIGH RANGE WATER-REDUCERS* (HRWR) are a special class of water-reducers. Often called superplasticizers, HRWRs reduce the water content of a given concrete from 12 to 25%, which increases strength.[4] HRWRs can also greatly increase the slump to produce "flowing" concrete. For example, adding a normal dosage of HRWR to a concrete with a slump of 3 to 4 inches will produce a concrete with a slump of about 8 inches. Within 30 to 60 minutes the concrete will return to its original slump. HRWRs are covered by ASTM Specification C 494.[2] Types F and G, and C 1017[5] Types 1 and 2.

References

1. ASTM C 260 "Standard Specification for Air-Entraining Admixtures for Concrete," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
2. ASTM C 494 "Standard Specification for Chemical Admixtures for Concrete."
3. "Understanding Chloride Percentages," NRMCA Publication No. 173.
4. "Superplasticizers in Ready Mixed Concrete," NRMCA Publication No. 158.
5. ASTM C 1017 "Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete."

Technical Information prepared by:
National Ready Mixed Concrete Association
900 Spring Street, Silver Spring, Maryland 20910

Printed in U.S.A.

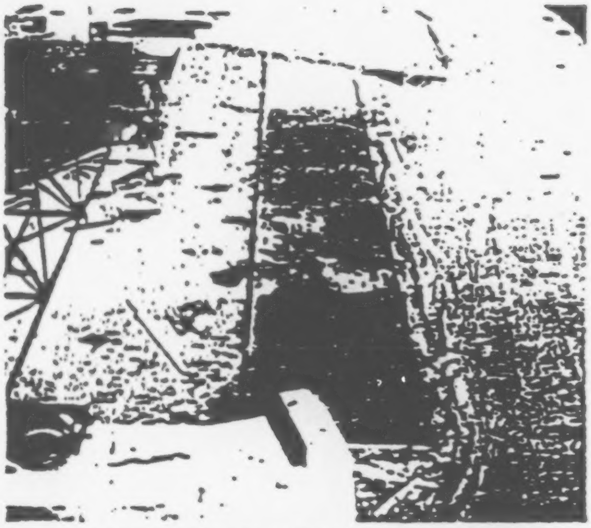
© NATIONAL READY MIXED CONCRETE ASSOCIATION, 1987

20M/12-87

How to minimize cracking and increase strength of slabs on grade

Remove excess water from the bottom

By Lee P. Nicholson
Assistant General Manager
Sequoia Rock Company



Preparation for casting one of the full-scale test slabs, 13 feet wide and 54 feet long. At the top is the impervious polyethylene base. The pervious sand base is in the foreground.

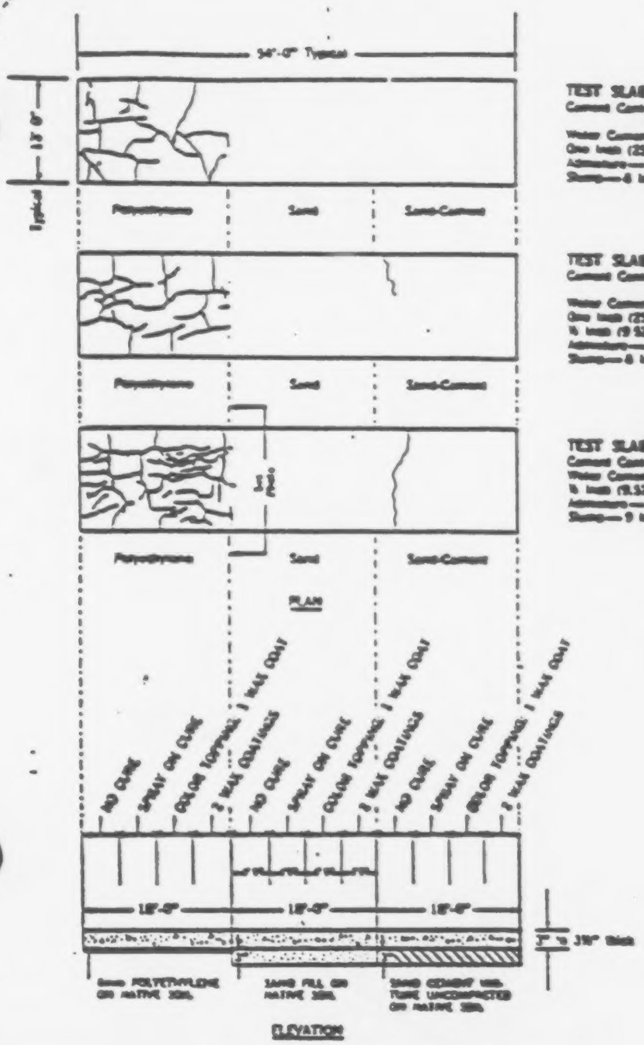
> Concrete mixes used in the test slabs described here are reportedly representative of field practice in southern California. They are not necessarily the mixes which would be recommended by the author or by other authorities on concrete slab construction.

The use of proper joint control to minimize cracking in slabs on grade has long been recognized and practiced, but only in the past two decades has the concrete industry dealt directly with a major cracking problem that joint control will not solve: plastic cracking and invisible plastic shrinkage that creates weakened areas which become shrinkage cracks later on. Plastic cracking, also referred to as plastic shrinkage cracking, is cracking that occurs in the surface of fresh concrete soon after it is placed and while it is still plastic.

Early efforts to solve this problem centered on changes in mix design, such as decreasing the slump, or external top surface treatments such as fog spray, wind breaks, and surface films. All of these help, but they have not provided a complete answer. However, I have long felt that the *bottom* of the concrete was the most important area in which to control cracking, and working from that base, I concluded that:

- If we can take the extra workability water from the mix out the bottom just as fast or a little faster than it goes out the top we can densify the concrete while it is in the plastic state. This will allow very little tensile stress to build up during the early curing.
- Then if the concrete is cured properly and adequate joints are provided, the cracking will take place only in the control joints. This, of course, will not take care of structural cracking or the every-now-and-then crack that seems to happen for no good reason, *but* it will eliminate the majority of our slab-on-grade cracking problems.

The Southern California Ready Mixed Concrete Association agreed to test this theory by casting identical slabs on different bases including impervious polyethyl-



TEST SLAB NO. 1
Cement Content 470 lb cu yd. (288.5 kg cu m)
Water Cement Ratio 0.697
One Inch (25.4mm) Gravel
Admixture—Color
Slump—8 inch (20 cm)

TEST SLAB NO. 2
Cement Content 517 lb cu yd. (312 kg cu m)
Water Cement Ratio 0.733
One Inch (25.4mm) and ⅜ Inch (9.52) Gravel
Admixture—None
Slump—8 inch (20 cm)

5½ sk

TEST SLAB NO. 3
Cement Content 611 lb. cu yd.
Water Cement Ratio 0.601
⅜ Inch (9.52mm) Gravel
Admixture—None
Slump—9 inch (22.9 cm)

6½ sk

Figure 1. *Details of the test slab program, showing three different base conditions as well as four curing conditions on each of the bases, for each slab. Three different concrete mixes are described on the right.*

A view across the width of Slab 3 shows cracks stopping at the edge of the sand-base area. Black spots are oil from trucks which use the test slabs as a parking area.

ene and pervious sand and sand-cement mixtures. The sand was wet down a day earlier to compact it, then lightly sprinkled just before placing the concrete. The sand-cement was not compacted and was as pervious as the sand. If my theory proved correct, the impervious base would induce plastic and shrinkage cracking; the sand would moderate it.

Each 13x54-foot test slab was cast on three different bases as shown in Figure 1. Finishers were allowed to add whatever water they felt they needed, according to current practice. A dry-shake topping was used on part of each slab, and curing included no treatment in some areas, spray-on compound and wax coatings in other areas.

Cracks were recorded after one year, and all but two occurred in the concrete cast directly on the polyethylene. Cracks in this surface stopped abruptly at the edge of the sand base area. The two cracks above the pervious base occurred more than 18 feet from any other cracks; such cracks might normally be expected since no joints were provided.

The results were clear, graphic and dramatic. Why was there serious cracking on the impervious base and none at all on the sand? Figure 2 shows the reasons. On the impervious base, all the extra bleed water must come out the top. As the top starts to dry, the concrete wants to curl. Because it can't take any tensile stress at this point, the slab starts to tear open on the top surface, creating immediately visible plastic shrinkage cracks as well as weakened areas where future cracking will occur. On the sand base, however, excess water leaves fairly evenly, top and bottom, enabling the concrete to densify without creating uneven stress within the slab. This prevents curling, virtually eliminates immediate plastic cracking and materially reduces the possibility of later shrinkage cracking.

Core tests made many months after casting have indicated another important advantage of the pervious base: greater strength. The table shows differences in core strength for various types of cure on each of the three bases. All of this concrete came from the same truck load. Concrete cast directly

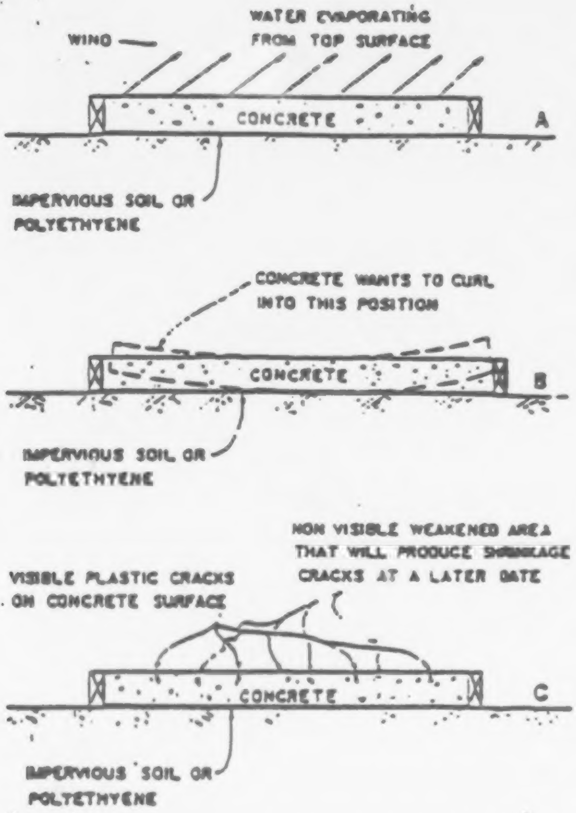

WIND
WATER EVAPORATING FROM TOP SURFACE
CONCRETE
A
IMPERVIOUS SOIL OR POLYETHYENE
CONCRETE WANTS TO CURL INTO THIS POSITION
CONCRETE
B
IMPERVIOUS SOIL OR POLTETHYENE
NON VISIBLE WEAKENED AREA THAT WILL PRODUCE SHRINKAGE CRACKS AT A LATER DATE
VISIBLE PLASTIC CRACKS ON CONCRETE SURFACE
CONCRETE
C
IMPERVIOUS SOIL OR POLTETHYENE

Figure 2. As water evaporates from the top of slab cast on polyethylene base (A), the concrete wants to curl into position shown (B). Since it cannot curl while it is still plastic, it starts to tear open (C). Other areas on the top may be weakening but do not show visible cracks.[1]

on polyethlyene and not cured had only 44 percent of the strength of concrete cast on a sand bed and spray cured. If the specified compressive strength were 2000 psi, the uncured concrete cast on the polyethylene would have failed, while the concrete cast on the sand was over strength.

COMPRESSIVE STRENGTH IN PSI OF CORES TAKEN FROM TEST SLAB 2 NINE MONTHS AFTER CASTING

TYPE OF BASE	TYPE OF CURE			
	none	sprayed	color plus one coat wax	two coats wax
polyethylene	1175	2125	1950	2125
sand	2250	2875	2925	2875
sand-cement	2800	2950	—	2625

The conclusion is inescapable; when concrete is cast on an impervious base such as polyethylene, clay, or tightly compacted soil, it has less strength and is much more susceptible to cracking than when it is cast on a pervious base such as sand. Ｃ

Acknowledgement
This article is condensed from a paper presented at the 1980 Annual Convention of the American Concrete Institute in Las Vegas. The full text will be available from the American Concrete Institute in a future issue of its monthly magazine, Concrete International. Related data were published in the ACI Journal, January 1978, pages 10-12.

Foundation Systems

Copied by permission

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

February 1990

TABLE NO. 29-A—FOUNDATIONS FOR STUD BEARING WALLS—MINIMUM REQUIREMENTS[1] [2]

NUMBER OF FLOORS SUPPORTED BY THE FOUNDATION[3]	THICKNESS OF FOUNDATION WALL (inches)		WIDTH OF FOOTING (inches)	THICKNESS OF FOOTING (inches)	DEPTH BELOW UNDISTURBED GROUND SURFACE (inches)
	CONCRETE	UNIT MASONRY			
1	6	6	12	6	12
2	8	8	15	7	18
3	10	10	18	8	24

[1] Where unusual conditions or frost conditions are found, footings and foundations shall be as required in Section 2907 (a).

[2] The ground under the floor may be excavated to the elevation of the top of the footing.

[3] Foundations may support a roof in addition to the stipulated number of floors. Foundations supporting roofs only shall be as required for supporting one floor.

TABLE NO. 29-B—ALLOWABLE FOUNDATION AND LATERAL PRESSURE

CLASS OF MATERIALS[2]	ALLOWABLE FOUNDATION PRESSURE LBS./SQ. FT.[3]	LATERAL BEARING LBS./SQ./FT./FT. OF DEPTH BELOW NATURAL GRADE[4]	LATERAL SLIDING[1]	
			COEF-FICIENT[5]	RESISTANCE LBS./SQ. FT.[6]
1. Massive Crystalline Bedrock	4000	1200	.70	
2. Sedimentary and Foliated Rock	2000	400	.35	
3. Sandy Gravel and/or Gravel (GW and GP)	2000	200	.35	
4. Sand, Silty Sand, Clayey Sand, Silty Gravel and Clayey Gravel (SW, SP, SM, SC, GM and GC)	1500	150	.25	
5. Clay, Sandy Clay, Silty Clay and Clayey Silt (CL, ML, MH and CH)	1000[7]	100		130

[1] Lateral bearing and lateral sliding resistance may be combined.

[2] For soil classifications OL, OH and PT (i.e., organic clays and peat), a foundation investigation shall be required.

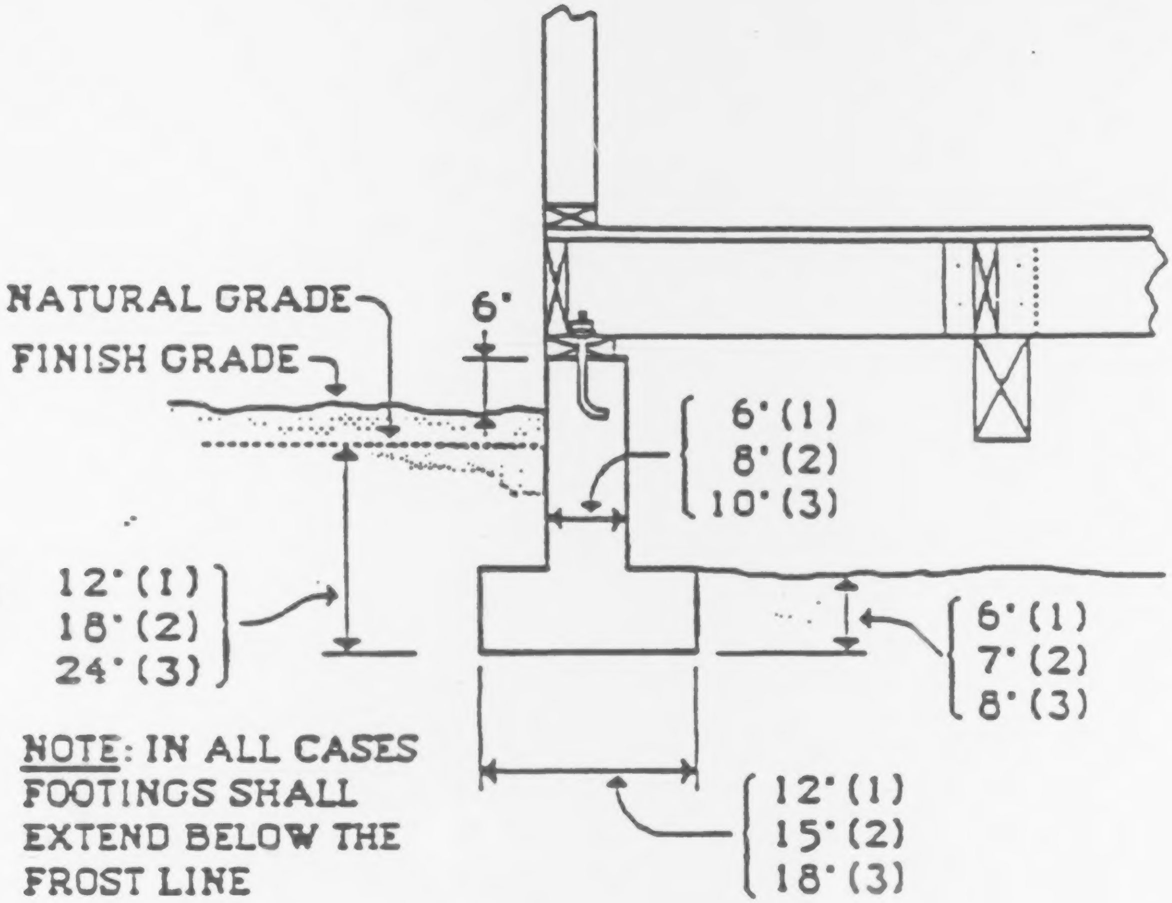
[3] All values of allowable foundation pressure are for footings having a minimum width of 12 inches and a minimum depth of 12 inches into natural grade. Except as in Footnote 7 below, increase of 20 percent allowed for each additional foot of width and/or depth to a maximum value of three times the designated value.

[4] May be increased the amount of the designated value for each additional foot of depth to a maximum of 15 times the designated value. Isolated poles for uses such as flagpoles or signs and poles used to support buildings which are not adversely affected by a 1/2-inch motion at ground surface due to short-term lateral loads may be designed using lateral bearing values equal to two times the tabulated values.

[5] Coefficient to be multiplied by the dead load.

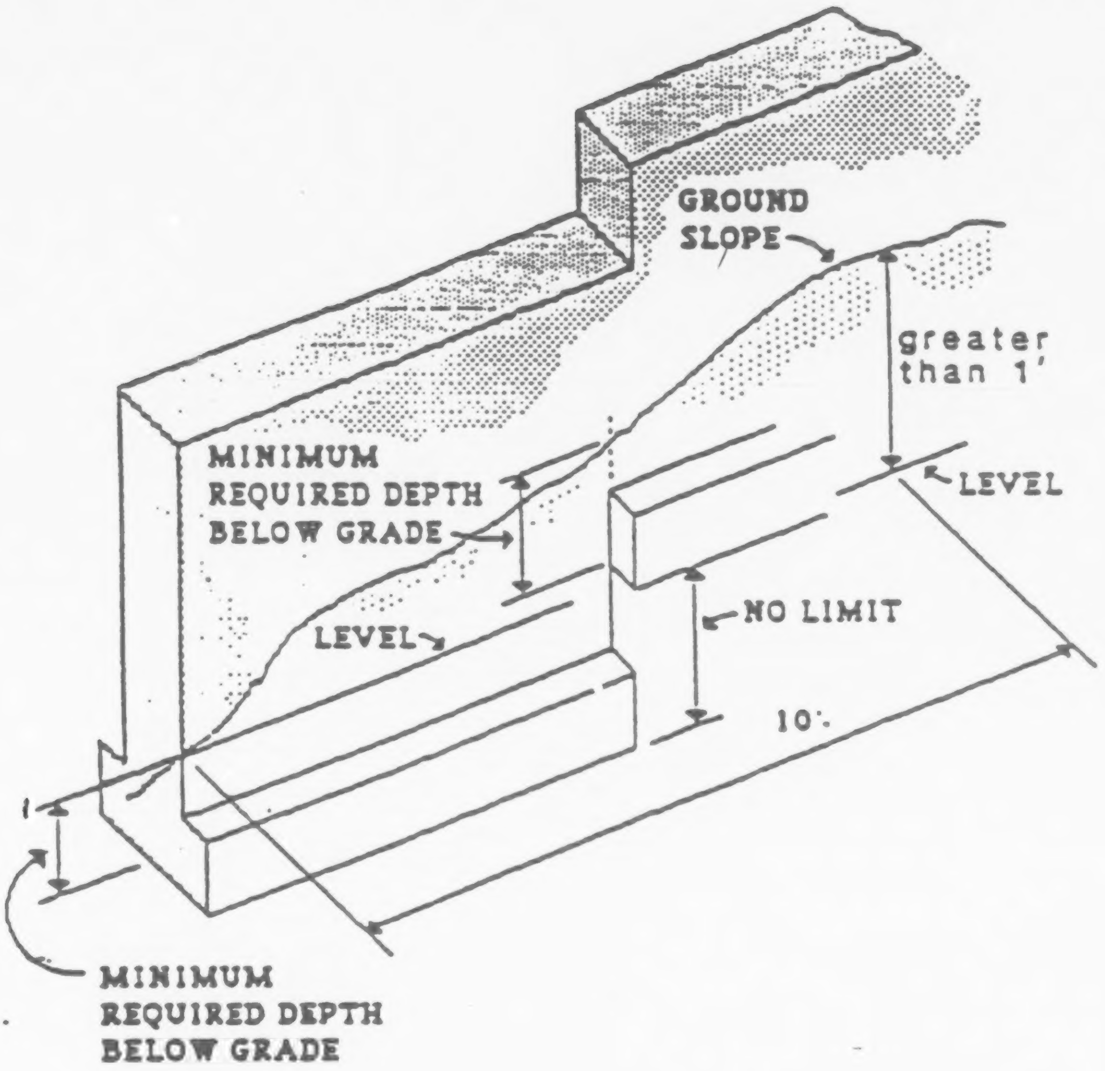
[6] Lateral sliding resistance value to be multiplied by the contact area. In no case shall the lateral sliding resistance exceed one half the dead load.

[7] No increase for width is allowed.


NATURAL GRADE
FINISH GRADE
6"
6" (1)
8" (2)
10" (3)
12" (1)
18" (2)
24" (3)
6" (1)
7" (2)
8" (3)
NOTE: IN ALL CASES FOOTINGS SHALL EXTEND BELOW THE FROST LINE
12" (1)
15" (2)
18" (3)

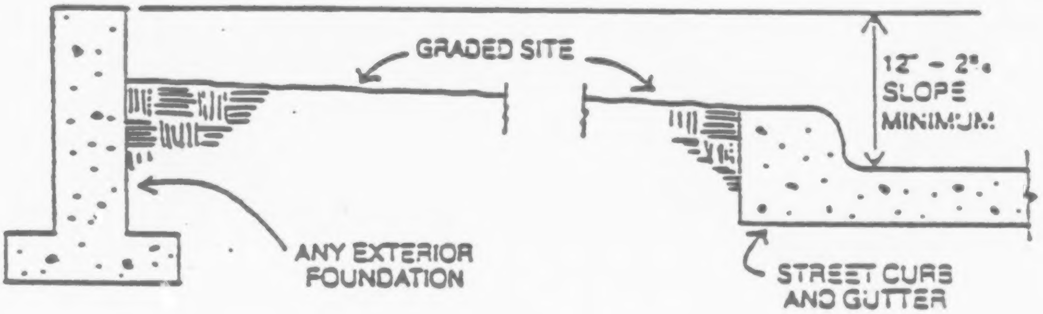
FOUNDATIONS FOR STUD BEARING WALLS

Sec. 2907 & Table No. 29-A


GROUND SLOPE
greater than 1'
LEVEL
MINIMUM REQUIRED DEPTH BELOW GRADE
NO LIMIT
LEVEL
10'.
1
MINIMUM REQUIRED DEPTH BELOW GRADE

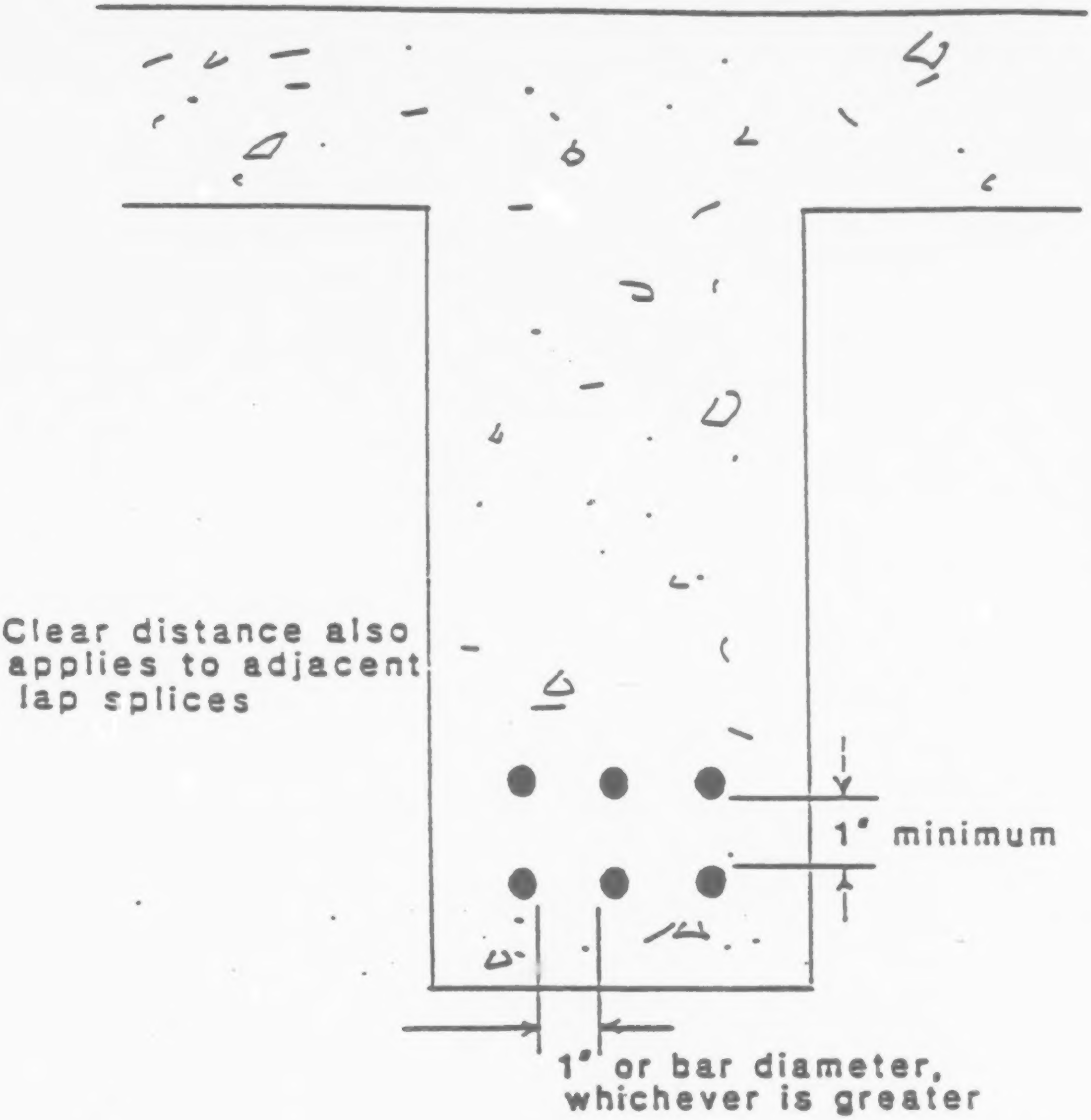
STEPPED FOOTINGS
Sec. 2907 (c)

NOTE: BUILDING OFFICIAL MAY APPROVE ALTERNATE
ELEVATIONS IF REQUIRED DRAINAGE IS PROVIDED


GRADED SITE
12" - 2%
SLOPE
MINIMUM
ANY EXTERIOR
FOUNDATION
STREET CURB
AND GUTTER

FOUNDATION ELEVATION

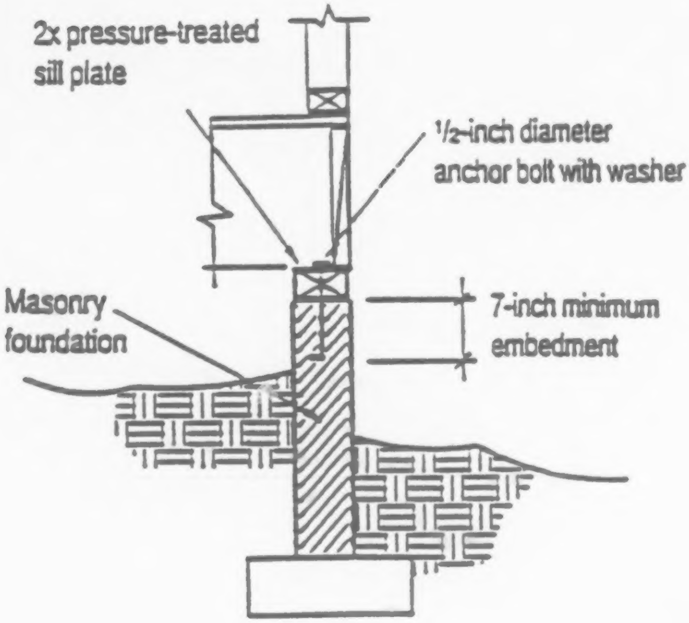
Sec. 2907 (d) 5

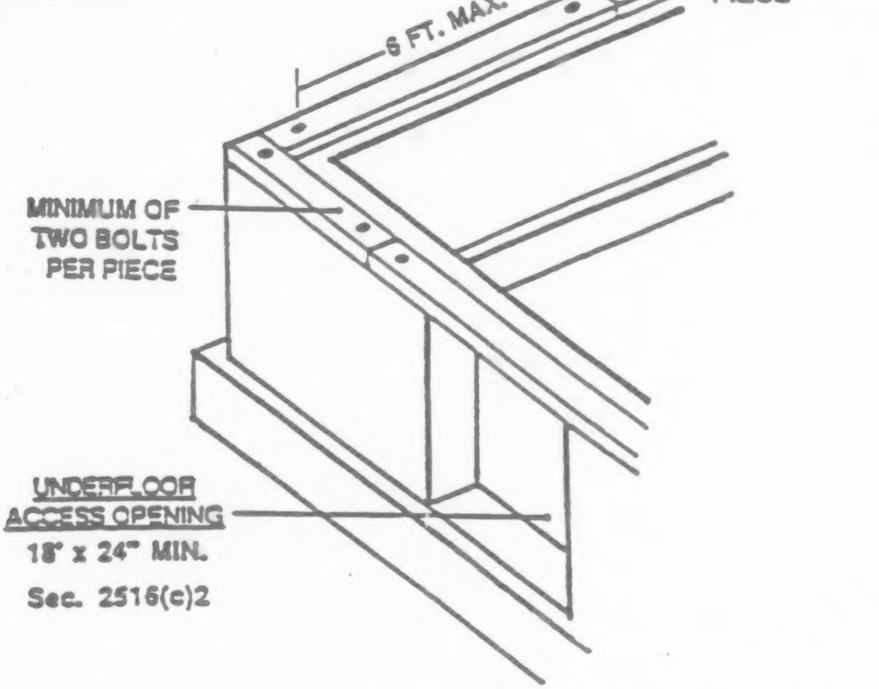

Clear distance also applies to adjacent lap splices
1" minimum
1" or bar diameter, whichever is greater

REINFORCEMENT CLEARANCES

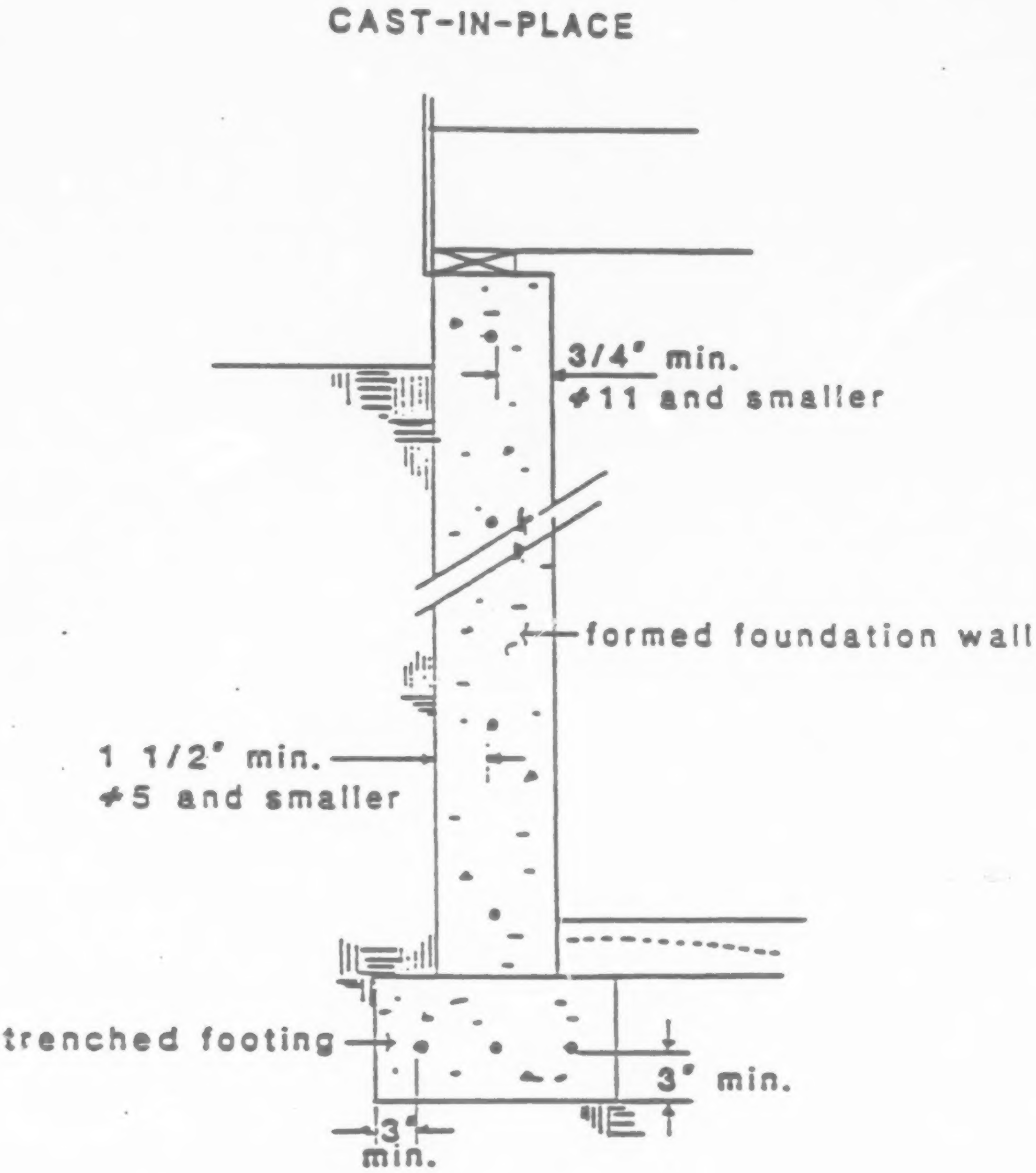
Sec. 2607(g)

FOUNDATION PLATES OR SILLS


2x pressure-treated sill plate
½-inch diameter anchor bolt with washer
Masonry foundation
7-inch minimum embedment


WITHIN 12 INCHES OF END OF EACH PIECE
6 FT. MAX.
MINIMUM OF TWO BOLTS PER PIECE
UNDERFLOOR ACCESS OPENING
18" x 24" MIN.
Sec. 2516(c)2

FOUNDATION BOLTS
Section 2907 (f)


CAST-IN-PLACE
3/4" min.
#11 and smaller
formed foundation wall
1 1/2" min.
#5 and smaller
trenched footing
3" min.
3" min.

CONCRETE PROTECTION FOR REINFORCEMENT

Sec. 2607(e)

HOT AND COLD WEATHER CONCRETING

CODE PROVISIONS
SECTION 2605

(f) **Cold Weather Requirements.** Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. All concrete materials and all reinforcement, forms, fillers and ground with which the concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.

(g) **Hot Weather Requirements.** During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation which will impair the required strength or serviceability of the member or structure.

POSSIBLE EFFECTS OF COLD WEATHER

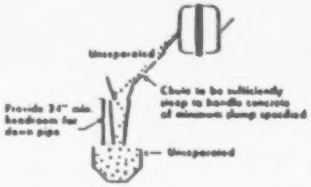
1. Permanent damage due to freezing.
2. Retarded hydration rate resulting in slower strength gain.
3. Freezing of the fresh concrete before it has hardened.
4. Durability is reduced in the same way that strength is reduced.
5. Freezing of corners and edges of the green concrete that has hardened but is still saturated with water and has practically no strength.
6. Dehydrated areas caused by lack of protection of the surface from space heaters. Cracking is liable to develop in such areas.
7. Cracking and disruption that occur later in the life of the structure as a result of the use of too much calcium chloride, or the use of the chloride in situations where it should not be used.
8. Cracking as the result of sudden temperature changes (thermal shock) imposed on the concrete before it has sufficient strength.

POSSIBLE EFFECTS OF HOT WEATHER

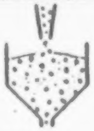
1. Increased water demand for required consistency.
2. Difficulty in control of entrained air.
3. Rapid evaporation of mixing water.
4. Rapid slump loss.
5. Accelerated set.
6. Difficulties with normal handling, finishing and curing.
7. Greater dimensional change on cooling hardened concrete.
8. Increased plastic shrinkage.
9. Increased tendency to crack or craze.
10. Reduced durability from increased water demand and cracking.
11. Reduced strength.
12. Variations in the appearance of the concrete surface.
13. Reduced bond of concrete to reinforcing steel.
14. Increased risk of steel corrosion from increased permeability and cracking.
15. Possible "cold joints."
16. Increased permeability.

Methods of Placing Concrete

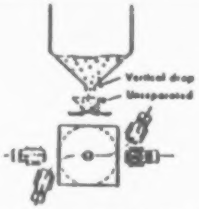
CORRECT


Unseparated
Chute to be sufficiently steep to handle concrete of minimum slump specified
Provide 24" min. headroom for down pipe
Unseparated

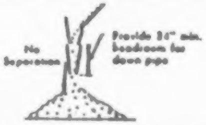
Above arrangement prevents separation regardless of length of chute.



Concrete should be dropped vertically directly over gate opening.

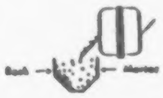

Vertical drop
Unseparated

Center discharge from hopper with vertical drop into center of buggy. Approach from opposite sides permits rapid loading.

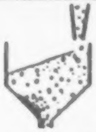

No Separation
Provide 24" min. headroom for down pipe

Above arrangement prevents separation no matter how short the chute whether conveyors being discharged into hoppers, cars, trucks or forms.

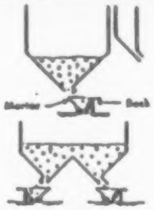
INCORRECT


Rock
Mortar

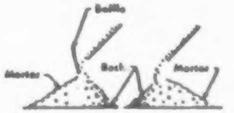
Filling of buckets, cars or hoppers directly from the mixer discharge may cause separation.



Dropping concrete on sloping sides of hopper should be avoided.


Mortar
Rock

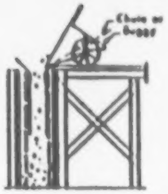
Sloping hopper gates which are in effect chutes without end control cause objectionable separation in filling the buggies.


Baffle
Mortar
Rock
Mortar

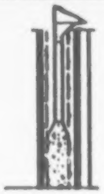
Improper or lack of control at end of any concrete chute, no matter how short, results in separation. Usually a baffle merely changes direction of separation.

Methods of Placing Concrete

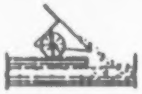
CORRECT


Chute or buggy

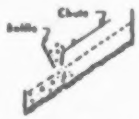
Separation is avoided by discharging concrete into hopper feeding into drop chute. This keeps forms and steel clean until concrete covers them.



Drop concrete vertically into rubber elephant trunk to control flow and prevent segregation.

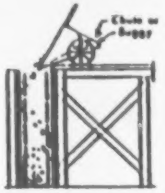


Concrete should be dumped into face of previously placed concrete.

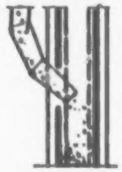

Baffle
Chute

A baffle and drop at end of chute will avoid separation and concrete remains on slope.

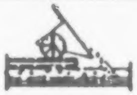
INCORRECT


Chute or buggy

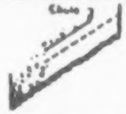
Permitting concrete from chute or buggy to strike against form and ricochet on bars and form faces causes separation and honeycomb at the bottom.



Permitting rapidly flowing concrete to enter forms on an angle invariably results in separation.



Dumping concrete away from previously placed concrete causes separation.



Discharging concrete from free end of chute onto a slope causes separation of rock which goes to bottom of slope. Velocity tends to carry concrete down the slope.

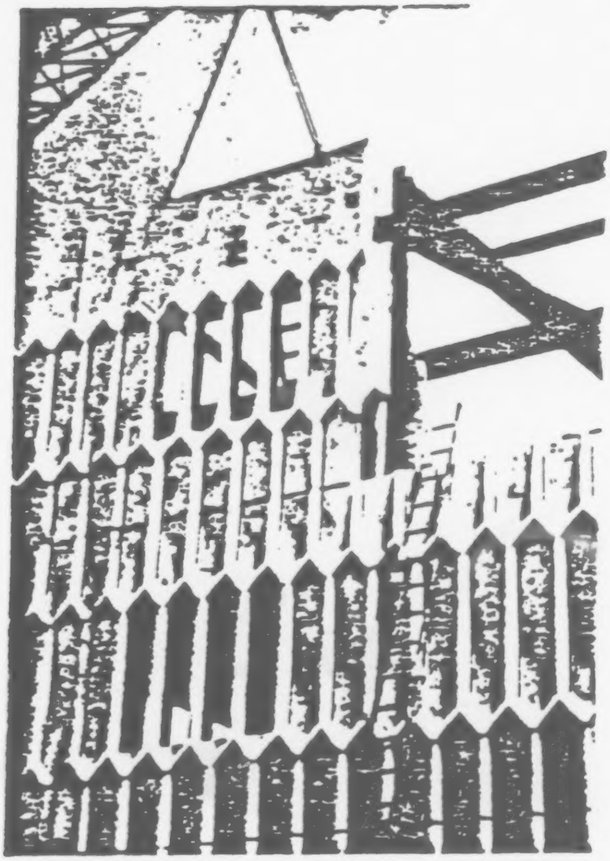


Figure 6-16. Precast wall units being lifted into place and attached to the building frame.

7 The Five Fundamentals*

This responsibility is implemented by the five fundamentals of concrete construction which are: investigation of the site, design of the structure, selection of materials and mix, workmanship in handling materials and concrete, and maintenance of the structure throughout its life. Now consider each of these five fundamentals to see how each of them can help to obtain good, durable concrete.

Inferior Workmanship. If we have selected o materials wisely, we should be well on our way to havi our quality concrete. But before we reach our goal, w have to put these materials together, mix them in concrete, transport the concrete to the forms, and the place, consolidate, finish and cure it. Much goo concrete has been ruined at some point during th journey.

Modern equipment and methods have steadily improved our ability to obtain good concrete. All perso concerned with concrete construction should be familia with the equipment and methods available and shoul make sure that the best procedures are followed. One o the most common faults is the use of too much mixin water. . . in other words, high slump. Wet, high-slum mixes are vulnerable because of shrinkage cracking an permeability of the ensuing concrete, and because we mixes are more apt to segregate than more moderate ones Segregation leads to rock pockets and weak, permeabl layers. (*Figure 4-3*) The wrong equipment or method can cause even good concrete to segregate. Weak, permeable layers will form where construction joints are not properly cleaned up. Finishing too soon, using water or dry cement to assist finishing, or overfinishing all result in deterioration of the surface. Porous concrete or honeycomb come as a result of insufficient consolidation. Deficiencies in curing are a constant source of distress.

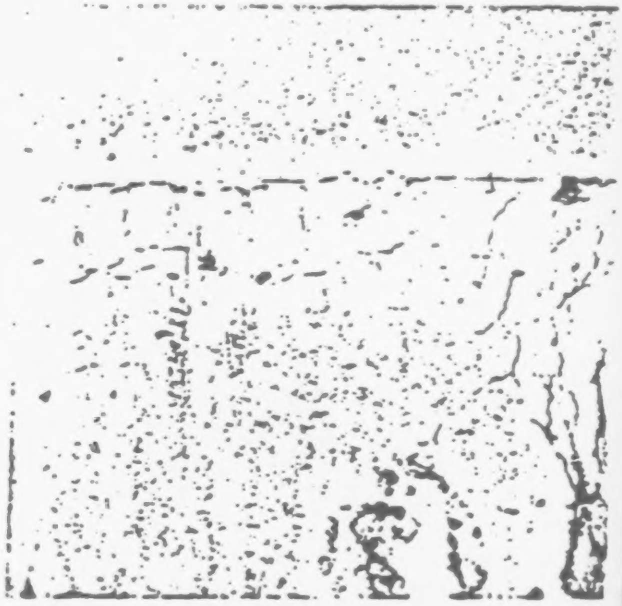


Figure 4-3. Shrinkage and cracking of weak concrete in the top of a lif of concrete at a construction joint resulting from an accumulation o wet, soupy concrete.

Temperature and Curing. The rate of reaction between the cement and water varies over a wide range of concrete temperatures, proceeding slowly at low temperatures somewhat above the freezing point of water, and more rapidly at high temperatures somewhat below the boiling point of water. Concrete temperatures below 50°F. are unfavorable for the development of early strength, and below 40°F. the development of strength is greatly retarded. At freezing temperatures strength development is practically absent. There is some evidence, on the other hand, that curing at temperatures in excess of 150°F. impairs the ultimate quality of the concrete.

A concrete temperature of 80°F. or above during and immediately after placing will result in lower ultimate strength compared with concrete mixed and placed at 40°F. to 80°F. Slow strength development and low early strength result from low curing temperature, but strength will be better if the concrete is cured at a more moderate temperature. *(Figures 3-10 and 3-11)*

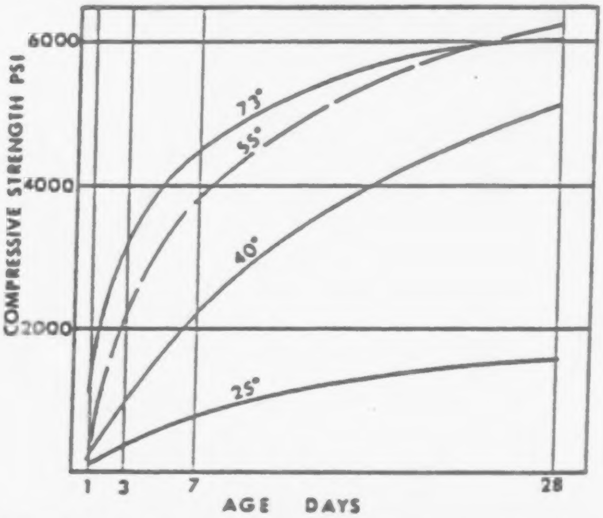


Figure 3-11. Concrete made and cured at low temperature does not develop strength as well as concrete made at 73°F., except that down to a temperature of 55°F. the difference at 28 days is very small, or the cooler concrete may actually have slightly more strength.

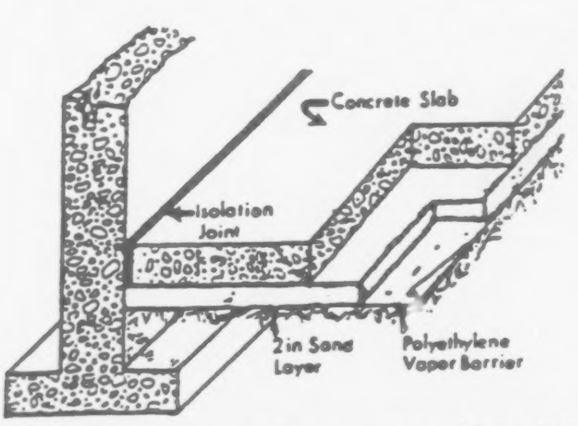


Figure 5-16. Section through a floor placed on a sand layer with a vapor barrier.

structure. An exception is the use of concrete for railroad ties, as the electrical properties can affect the signalling system. Dry concrete is a good insulator. Moist concrete has a fairly high resistance to the flow of electricity, but not as good as dry concrete.

5 Cold Weather

Cold weather can damage concrete in either of two ways: first, by freezing of the fresh concrete before the cement has achieved final set, and second, by repeated cycles of freezing and thawing over a period of months or years.

Freezing of Fresh Concrete. Only one freezing of the concrete while still in the plastic state or during the initial hardening period may reduce durability, weathering resistance, and strength by as much as one-half. The length of the period during which the concrete is frozen is not important, once the concrete has frozen, and the amount the temperature drops below freezing appears to have no effect. Once frozen, concrete will never attain its full potential strength and durability, even after prolonged curing at reasonable temperatures. There is no material or admixture that can be added to the fresh concrete to lower its freezing temperature, or act as an anti-freeze. How to mix and handle concrete during freezing weather is discussed in Chapter 19.

Frost Action. Frost, or cycles of freezing and thawing, damages hardened concrete by the freezing and consequent expansion of water in pores and openings in the concrete. Thus it may be seen that dry concrete is little affected by such action. However, most concrete that is exposed to cold temperatures is also exposed to moisture or water and is therefore subject to attack.

Causes of poor frost resistance include poor design construction joints; segregation of concrete while pl[illegible]ing; leaky formwork and poor workmanship resulting in honeycomb and sand streaks; faulty cleanup of a joint surface before placing concrete against it; flat surfaces that allow puddles of water to collect on the surface of the concrete; insufficient or totally lacking drainage, permitting water to accumulate against the concrete; and cracks. The fineness and composition of the cement, within the limits normally specified, appear to have little or no effect.

To provide resistance against frost requires that good design principles be followed, taking care that proper and adequate drainage is provided. Horizontal construction joints should be avoided if possible. However, if such a joint is necessary, it should not be located near the water or ground line, but should be two or three feet above the ground line or high water line, or the same distance below the ground or low water line. Thorough cleanup of the previously placed concrete is essential. Concrete should contain a maximum of 7 percent air for ⅜-inch or ½-inch maximum aggregate, ranging down to 3 or 4 percent for cobble mixes, and should be made of first class materials, carefully mixed and handled, with a water-cement ratio as low as possible. (See Chapter 12).

Structurally sound aggregate of low porosity should be used. Good construction practices should be followed throughout, under proper supervision and inspection. Segregation, sand streaks and honeycomb must be avoided by careful placement of the concrete as near a[illegible] possible in its final resting place, followed by thorough consolidation by means of internal vibrators. The objective is to produce good concrete with smooth, dense and impermeable surfaces.

These relationships hold true for any kind of aggregate and age of concrete. It was also found that concrete with the smaller MSA has greater compressive strength than large MSA concrete at the same water/cement ratio. pecially at W/C ratios below 0.50. This information is own in Figure 3-8.

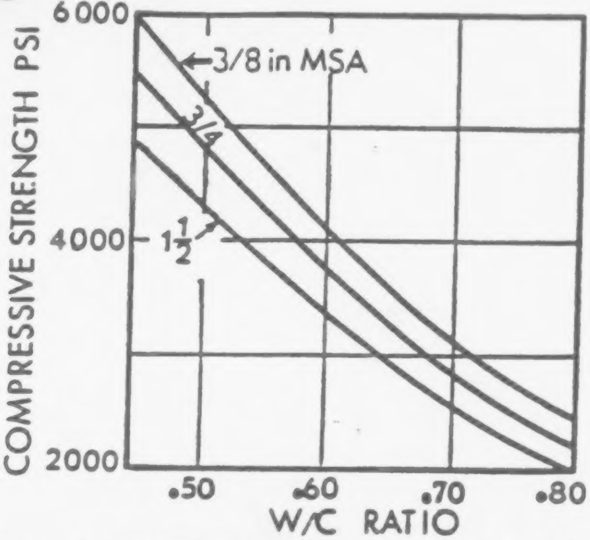
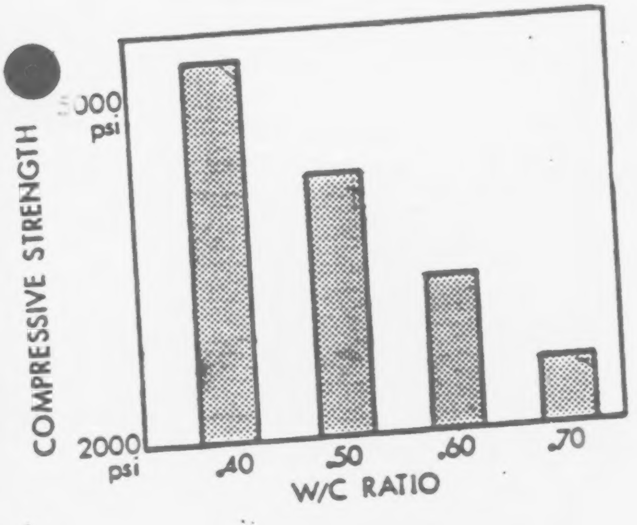


Figure 3-8. Small MSA concrete has higher strength than large MSA concrete at the same water-cement ratio.



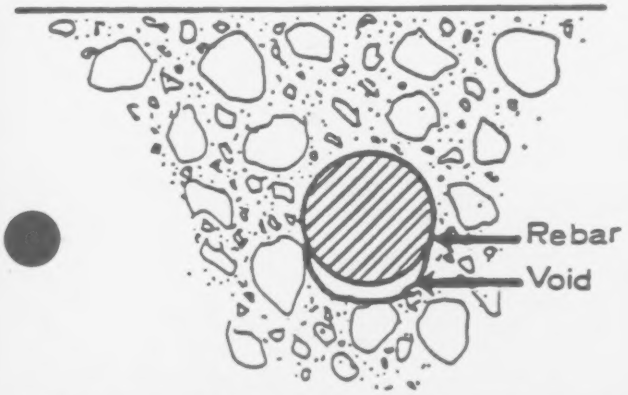


Figure 2-12. Bond with a reinforcing bar may be damaged by formation of water voids beneath the bar.

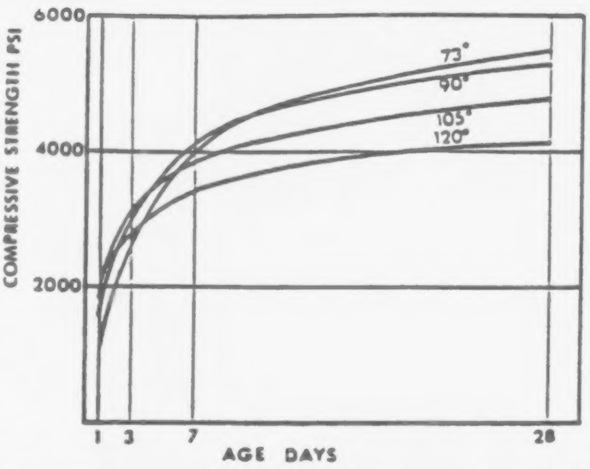


Figure 3-10. Concrete made and cured at high temperatures has high early strength up to an age of four of five days, but beyond that time the strength is not as good as that for concrete made at 73°F. The strength difference continues beyond 28 days.

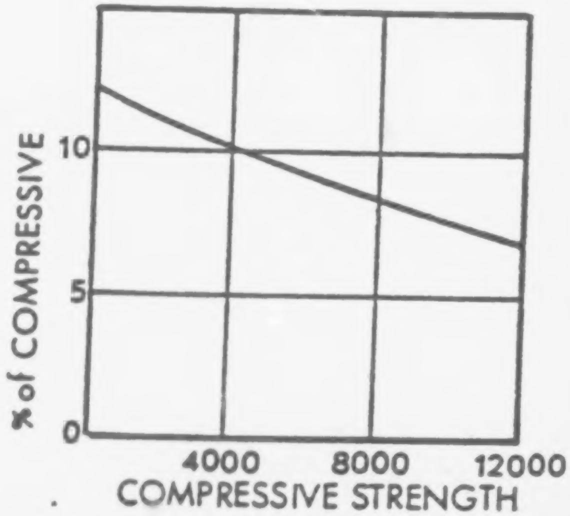


Figure 3-6. Tensile strength of concrete is about 12 percent of the compressive for low strength concrete, going down to about 7 percent for high strength concrete.

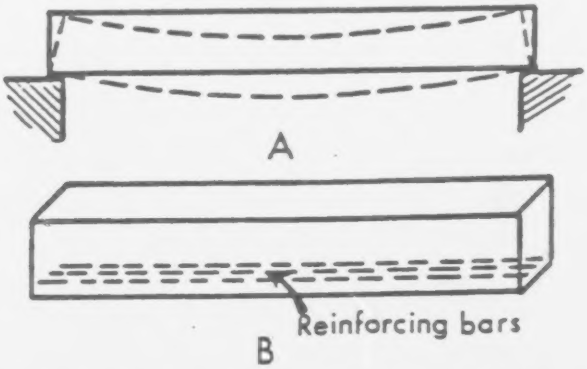


Figure 3-3. The bottom of a beam is in tension when the beam is loaded, so reinforcing bars are put in the bottom of the beam to give it greater flexural strength.

LEARN TO EARN
WITH
HEAVY EQUIPMENT OPERATION TRAINING

SPONSORED BY
BOISE STATE UNIVERSITY

WHEN: Starting March 12, 1990

WHERE: Boise, Idaho

LENGTH: Eight weeks--8 a.m. - 5 p.m.

COST: $2,000 per participant

CURRICULUM:
- Equipment nomenclature and safety
- Operation and service maintenance of equipment
- Field application of equipment (doser, scraper, grader, loader, roller and backhoe)

ELIGIBILITY: 18 years of age, good physical condition, high school graduate or GED, and like working out of doors. Valid drivers license.

HOW TO APPLY: Call or write:
Vocational Student Services
College of Technology
Boise State University
1910 University Drive
Boise, ID 83725
Phone: (208) 385-1144
Toll free within Idaho 1-800-632-6586

Eligible applicants may qualify for Job Training Partnership Act (JTPA) funding. Contact Jane Giles, JTPA Coordinator, 385-3353. Toll free within Idaho 1-800-632-6586, ext. 3353.

Boise State University is an equal opportunity/affirmative action institution.

HEAVY EQUIPMENT OPERATOR
TRAINING ACHIEVEMENT RECORD

NAME ______________________ SSN ____________________ CENTER ______________________

DATEENTERED TRAINING: ____________ DATE COMPLETED (OR TERMINATED): ____________ ADDRESS ______________________

____

STATUS: NON-COMPLETER _____ Oiler - 899.687-018

COMPLETER _____ (A) Back Hoe Operator - 850.683-030
_____ (B) Front End Loader - 921.683-042
_____ (C) Motor Grade Operator - 850.663-022
_____ (D) Crawler Tractor Operator - 850.683-010
_____ (E) Scraper Operator - 850.683-038

ADVANCED COMPLETER _____ (F) Heavy Equip. Operator - 859.683-010

TELEPHONE NO. ______________________

DUTIES AND TASKS	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS	COMPLETER LEVEL					
				A	B	C	D	E	F
A. Basic Heavy Equipment									
1. Identify and Demonstrate Hand Tools, Adhere to Safety Practices	________	________	________	X	X	X	X	X	X
2. Practice Preventive Maintenance	________	________	________	X	X	X	X	X	X
3. Identify Types of Equipment and their Functions	________	________	________	X	X	X	X	X	X
4. Identify Components of Fuel System	________	________	________	X	X	X	X	X	X
5. Identify Components of Lubrication System	________	________	________	X	X	X	X	X	X
6. Identify Components and Principles of Air Induction and Exhaust System	________	________	________	X	X	X	X	X	X
7. Explain Flow of Coolant Through Cooling System	________	________	________	X	X	X	X	X	X
B. Advance Heavy Equipment Operator									
1. Explain Safety and Emergency Procedures, Proper Gauge Ranges	________	________	________	X	X	X	X	X	X
2. Set and Identify Grade Stakes	________	________	________	X	X	X	X	X	X

DUTIES AND TASKS	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS	COMPLETER LEVEL A	B	C	D	E	F
C. Dozer Operator									
1. Explain Safety Precautions and Emergency Procedures							X		X
2. Perform Prestart, Starting, and Shutdown Procedures							X		X
3. Explain Control Functone and Perform Basic Operations							X		X
4. Perform Push Cat and Ripper Operation							X		X
5. Fill Applications Behind Scrapers and Back Dumps							X		X
6. Demonstrate Benching and Sloping with a Dozer							X		X
7. Demonstrate Cutting and Filling with a Dozer							X		X
8. Cut Ditches with a Dozer							X		X
9. Clear Land of Trees or Boulders and Stockpile							X		X
D. Grader Operator									
1. Explain Safety Precautions and Emergency Procedures						X			X
2. Perform Prestart, Starting and Shutdown Procedures						X			X
3. Explain Control Functions and Perform Basic Operation						X			X
4. Maintain a Haul Road						X			X
5. Demonstrate Cutting Ditches with a Grader						X			X
6. Demonstrate Cutting and Filling with a Grader						X			X
7. Demonstrate Sloping with a Grader						X			X

DUTIES AND TASKS	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS	COMPLETER LEVEL A	B	C	D	E	F
E. Loader Operator									
1. Explain Safety Precautions and Emergency Procedures					X				X
2. Perform Prestart, Starting, and Shutdown Procedures					X				X
3. Explain Control Functions and Perform Basic Operations					X				X
4. Load Out of a Bank or Stockpile					X				X
5. Load Haul Units Using a Loader					X				X
6. Build a Stockpile					X				X
F. Backhoe Operator									
1. Explain Safety Precautions and Emergency Procedures				X					X
2. Perform Prestart, Starting, and Shutdown Procedures				X					X
3. Explain Control Functions, and Perform Basic Operations				X					X
4. Dig a Trench to Specifications and Backfill				X					X
5. Dig a Pit to Specifications and Backfill				X					X
6. Uncover Buried Lines or Pipes				X					X

DUTIES AND TASKS	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS	COMPLETER LEVEL A	B	C	D	E	F
G. Scraper Operator									
1. Explain Safety Precautions and Emergency Procedures								x	x
2. Perform Prestart, Starting, and Shutdown Procedures								x	x
3. Explain Control Functions and Perform Basic Operations								x	x
4. Load to Capacity, Leaving a Smooth Level Cut								x	x
5. Transport Loaded Scraper Properly According to Conditions								x	x
6. Spot Dump a Scraper								x	x
7. Spread Material with Scraper								x	x
8. Building and Load Out of Stockpiles								x	x
9. Cut and Fill to Specifications								x	x
10. Maneuver a Scraper in Close Quarters								x	x

DIRECTIONS FOR COMPLETING THE TRAINING ACHIEVEMENT RECORD AND DETERMINING THE COMPLETER LEVEL FOR STUDENTS IN THE HEAVY EQUIPMENT OPERATOR PROGRAM

A. When the student successfully performs each of the tasks listed in the left column of the TAR the instructor should:

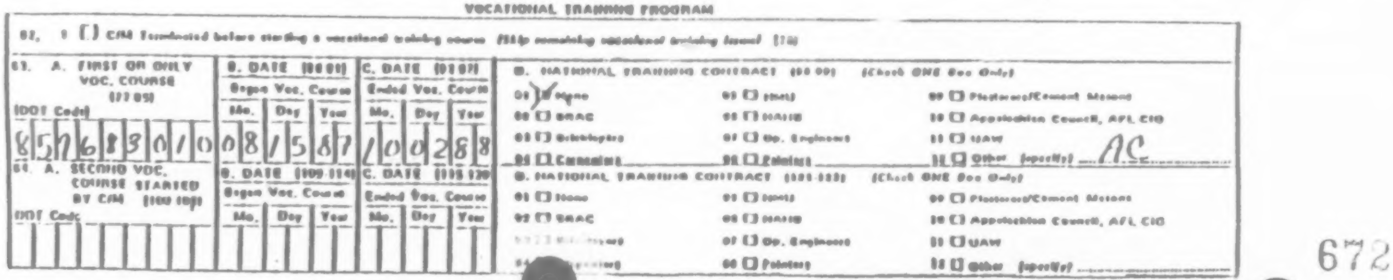
(1) write the date that the student mastered the task in the column labeled "Date Completed",
(2) sign his/her (instructor's) initials in the column labeled "Instructor's Initials",
(3) have the student sign his/her initials in the column labeled "Student's Initials", and
(4) circle all of the "X"s shown (in the columns labeled "Completer Level") which correspond to the task completed.

B. When the student has completed the training offering or terminated from the program the instructor should:

(1) enter the date completed (or terminated) on the space provided at the top of the first page of the TAR,
(2) determine whether the student was a non-completer, a completer or an advanced completer according to the directions in step C (below) and place an "X" in the appropriate box under "Status" on the top of the first page of the TAR, and
(3) complete the certification on the last page of the TAR.

C. To determine the "Status" of a student in the Heavy Equipment Operator program (i.e. non-completer [NC], completer [C] or advanced completer [AC]) the instructor should use the following guidelines:

(1) Go to the column labeled "Completer Level" (on the right side of the TAR); if all the "X"s in the first column labeled "A" have been circled and verified by the instructor's initials, the student is a completer at D.O.T. Level A, Back Hoe Operator. Check the blank before D.O.T. Level A, Back Hoe Operator in the upper left hand corner of the TAR.
(2) Go to column "B" and repeat the process described in step 1. Continue the process through the remaining columns, checking the blank before every D.O.T. level completed.
(3) An Advanced Completer, D.O.T. Level F, Heavy Equipment Operator, is a student who has completed and three (3) completer levels A through E. (For example, a Heavy Equipment Operator is a student who has completed all tasks in Completer levels A-Back Hoe Operator, B-Front End Loader, and D-Crawler Tractor Operator.)
(4) If the student did not complete all of the tasks required in any of the lettered columns, check the blank before the "Non-Completer" D.O.T. Level, Oiler.
(5) Record the highest D.O.T. and completer level achieved on the Job Corps Student Profile (Form ETA 6-40). All student profiles must be coded with "NC" if they are non-completers, "C" if they are completers, and "AC" if they are advanced completers. Because time needs to be allowed to modify the Job Corps Student Profile to accommodate the new completer codes, centers must temporarily put the appropriate code ("NC", "C", "AC") in item #53, D-12, Other, on side four of ETA 6-40. The center will place an "X" in one of the boxes in Section D (National Training Contract) from 01/None to 11/UAW. Do not mark box 12/Other. Specify the completer designation by writing the code (NC, C or AC) on the line after the code 12 box, as shown in the example below.



VOCATIONAL TRAINING PROGRAM

63. A. FIRST OR ONLY VOC. COURSE
(DOT Code)
8 5 7 6 8 3 0 1 0

B. DATE
Began Voc. Course
Mo. 08 Day 15 Year 87

C. DATE
Ended Voc. Course
Mo. 10 Day 02 Year 88

D. NATIONAL TRAINING CONTRACT (Check ONE Box Only)
01 ☒ None
07 ☐ Op. Engineers
11 ☐ UAW
12 ☐ Other (specify) AC

64. A. SECOND VOC. COURSE STARTED BY CM
(DOT Code)

B. DATE
Began Voc. Course
Mo. Day Year

C. DATE
Ended Voc. Course
Mo. Day Year

D. NATIONAL TRAINING CONTRACT (Check ONE Box Only)
01 ☐ None
07 ☐ Op. Engineers
11 ☐ UAW
12 ☐ Other (specify)

(SIDE FOUR ETA 6-40)

HEAVY EQUIPMENT OPERATOR
CERTIFICATION

Student's Name ______________________ Date Student Completed Training ____________

The student has completed ____ hours of work experience at ________________ as a ____________.
(Name of Business) (Job Title)

The student named above has terminated from this training program and has completed each of the signed (initialed) tasks as approved by the National Office of Job Corps.

____
Instructor Signature

____
Student Signature

COMMENTS This student is recommended to begin employment as (a/an)______________________________

COURSE OBJECTIVE

This program is developed as a positive cooperative joint venture between vocational education and the Operating Engineers Training program. The objective is to train females and minorities to be safe and yet productive construction workers while operating heavy construction equipment. The program allows individuals without prior training and skills to be given a chance to enter the construction industry, thus assisting contractors in meeting their federal EEO compliance goals. The objectives of this subproposal are:

Boise State University will conduct the screening and selection of all applicants. The objectives of this subproposal are:

- Joint venture between vocational education and a union training program
- The majority of available openings will be available for female and minorities as identified as a goal in the CD grant.
- Assist contractors in meeting their federal EEO Compliance goals
- Provide the industry with safe and productive new entry operators.

INSTRUCTIONAL OBJECTIVE

As in all construction training programs the basic thread interwoven in all aspects of training is safety. Because of the potential for serious injuries when working with and around heavy equipment, safety becomes a major objective. Much of safety is an attitude developed from pervious experiences. Therefore, the development of a safety conscious operation is of the highest priority. Attitudes are hard to evaluate except by conduct and performance in the operation of equipment. Therefore all skill development is conducted under the "safety first" principle.

Skill development objectives include proper operation of equipment and basic service and field maintenance. Skill development and confidence in equipment operation including dozers, scrapers, graders, backhoes, loaders, rollers and forklifts will be the nucleus of the curriculum. The objectives of skill development centers around those specific pieces of equipment.

PROGRAM ACTIVITIES

Safety

- Wearing of personal protective equipment
- Practice of first aid and CPR techniques
- Demonstrate hand signals for boom equipment operation
- Operate equipment in a safe and controlled manner
- Describe safety rules and regulations

Forklift

- Identify the components of a forklift
- Conduct a safety inspection of equipment
- Practice correct starting and stopping procedures
- Raise and lower mash
- Operate and practice equipment without load
- Operate and practice pick up and unloading pallets of material
- Conduct basic servicing and maintenance of equipment

Dozers and Scrapers

- Identify major components of a dozer and scraper
- Inspection of equipment before operation
- Conduct starting and stopping procedures
- Operation of bowl, apron and tailgate
- Loading, hauling and spreading
- Push loading, drifting, ripping and pioneering
- Conduct service and maintenance check

Graders

- Identify major components of a grader
- Inspect equipment before starting
- Practice starting and stopping procedures
- Practice basic machine maneuvering
- Demonstrate blade positions
- Operation of equipment in all blade positions
- Conduct service and maintenance check

Loaders

- Identify major components of a loader
- Inspect equipment before starting
- Practice starting and stopping procedures
- Practice basic machine maneuvering
- Demonstrate truck loading
- Demonstrate stock piling techniques
- Conduct a service and maintenance check

Backhoes

- Identify major components of a backhoe
- Inspect equipment before operation
- Practice starting and stopping procedures
- Practice putting out and taking in outriggers
- Practice backhoe and loader operation
- Practice basic machine maneuvering
- Practice digging
- Demonstrate operation of all hydraulic units
- Conduct service and maintenance procedures

Rollers

- Identify major components of a roller
- Inspect equipment before starting
- Practice starting and stopping procedures
- Practice basic machine maneuvering
- Demonstrate proper roller patterns
- Conduct service and maintenance procedures

Servicing and Maintenance

- Pre-inspection of equipment
- Oil and filter change
- Lubrication of equipment
- Replacement of hydraulic hoses
- Water level check
- Adjustments of hydraulic levers

EQUIPMENT AND TOOLS

12 hard hats
12 pairs safety glasses
1 set of sockets (complete)
1 set of end wrenches (complete)
1 arc welding machine
1 oil pit
3 oil drums
25 oil and air filters
12 ear protection sets

Classroom Equipment

- slide projector
- 16mm film projector
- TV and VCR
- Tape recorder
- AV screen

Audiovisuals

Films - 16mm Caterpillar Company
- "800 Miles of Winter"
- "Loading Logic"
- "Color of Danger"
- "Operators Guide--Tract Type Tractors"
- "Operators Guide--Rubber-tired Tractors"
- "Operators Guide--Motor Graders"
- "Operators Guide--Loaders"
- "Operators Guide for Hydraulic Excavators"
- "Making the Most with Scrapers"
- "Ripping"
- "Winning Moves in Maintenance"
- "Challenge of Safety"

Printed Material

Books

- Moving The Earth - North Castle Books
- Equipment Maintenance and Repair - North Castle Books

Manuals - Caterpillar Company
- Operating Manuals - Caterpillar
- Dozers
- Scrapers
- Graders
- Backhoes
- Rough Terrain Forklift - Cement Association
- First Aid and CPR - American Red Cross